DOUBLE NUMBER

VOL. XXXV JUNE, 1920 Nos. 3 & 4

JOURNAL

OF THE

Elisha Mitchell Scientific Society

CONTENTS

Chlorination by Mixed Carbon Monoxide and Chlorine. *Francis P. Venable* and *D. H. Jackson* 87

A Rapid Volumetric Method for the Determination of Arsenic in Arsenates. *James M. Bell*..... 90

The Land of Ferns. *John K. Small* 92

The Regional Geography of South Carolina Illustrated by Census Statistics. *Roland M. Harper* 105

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ISSUED QUARTERLY

CHAPEL HILL, N. C., U. S. A.

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JOURNAL OF THE ELISHA MITCHELL SCIENTIFIC SOCIETY—Quarterly. Price $2.00 per year; single numbers, 50 cents. Most numbers of former volumes can be supplied. Direct all correspondence to the Permanent Secretary, at the University of North Carolina, Chapel Hill, N. C.

In addition to original papers on scientific subjects this Journal publishes the Proceedings of the Elisha Mitchell Scientific Society, and the Proceedings of the North Carolina Academy of Science, as well as abstracts of papers on scientific subjects published elsewhere by members of the Faculty of the University of North Carolina.

JOURNAL

OF THE

Elisha Mitchell Scientific Society

VOLUME XXXV
1919-1920

ISSUED QUARTERLY

Published for the Society
by the
University of North Carolina

CONTENTS

Proceedings of the Eighth Meeting of the North Carolina Academy of Science 1

Notes on Occurrence of *Tintinnus serratus* in Chesapeake Bay. *Bert Cunningham* 12

On Some Generic Distinctions in Sponges. *H. V. Wilson* 15

A Portable Printing Press for the Ecologist. *Z. P. Metcalf* 20

Craterellus, Cantharellus, and Related Genera in North Carolina; with a Key to the Genera of Gill Fungi. *W. C. Coker* 24

Juglone. *Alvin S. Wheeler* 49

Our Rats, Mice and Shrews. *C. S. Brimley* 55

Notes on the Flora of Church's Island, North Carolina. *W. L. McAtee* 61

The Distribution of *Rhododendron catawbiense*, with Remarks on a New Form. *W. C. Coker* 76

Chlorination by Mixed Carbon Monoxide and Chlorine. *Francis P. Venable* and *D. H. Jackson* 87

A Rapid Volumetric Method for the Determination of Arsenic in Arsenates. *James M. Bell*..... 90

The Land of Ferns. *John K. Small* 92

The Regional Geography of South Carolina Illustrated by Census Statistics. *Roland M. Harper* 105

Notes on the Lower Basidiomycetes of North Carolina. *W. C. Coker* 113

PLATE 23

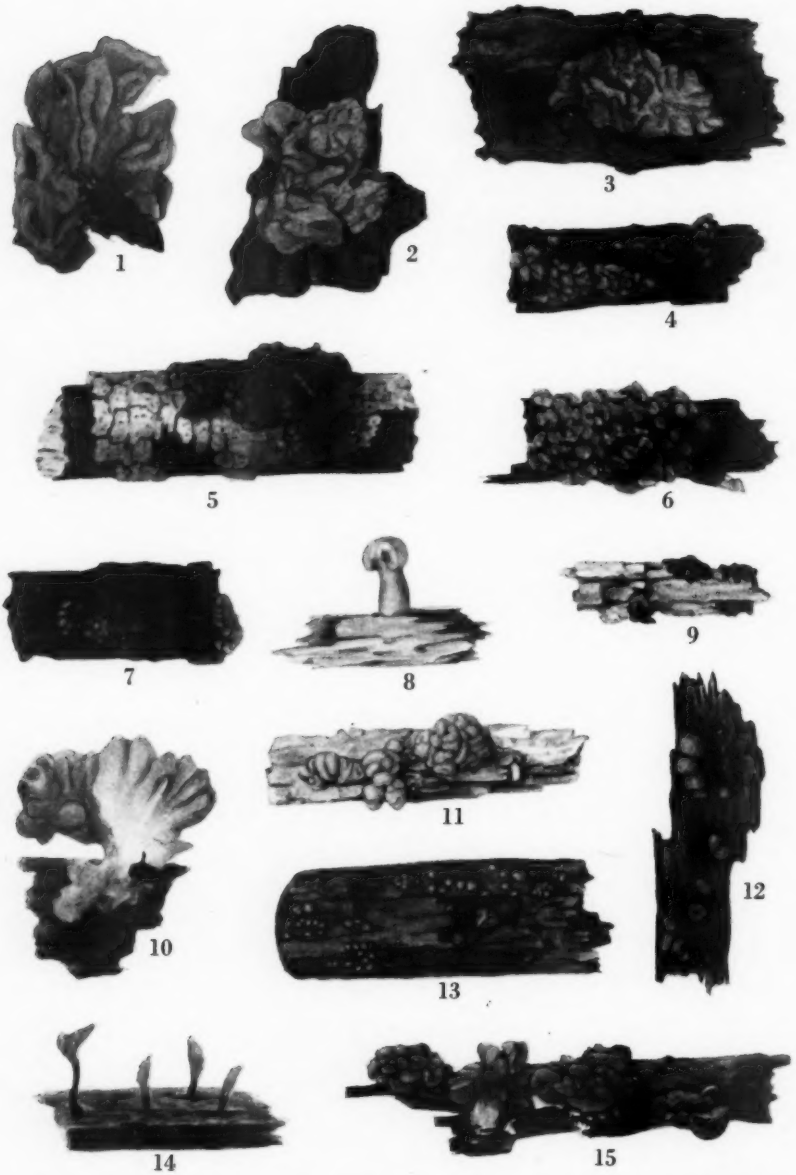


FIG. 1. NAEMATELIA QUERCINA. No. 3935. FIG. 2. TREMELLA LUTESCENS. No. 3895. FIG. 3. NAEMATELIA NUCLEATA. No. 4023. FIG. 4. NAEMATELIA NUCLEATA. No. 3961. FIG. 5. TREMELLA VIRENS. No. 4070. FIG. 6. TREMELLA CARNEOALBA. No. 3877. FIG. 7. DACRYMYCES PALLIDUS. No. 4072. FIG. 8. DACRYOMITRA DUBIA. No. 3969. FIG. 9. DACRYMYCES FUSCOMINUS. No. 4075. FIG. 10. DACRYMYCES AURANTIUS. No. 3500. FIG. 11. DACRYMYCES ELLISII. No. 4035. FIG. 12. DACRYMYCES ABIETINUS. No. 3832. FIG. 13. PLATYGLOEA CAROLINIANA. No. 4199. FIG. 14. GUEPINIA SPATHULARIA (a small form on pines). No. 3998. FIG. 15. DACRYMYCES PEDUNCULATUS. No. 4185.

JOURNAL

OF THE

Elisha Mitchell Scientific Society

Volume XXXV JUNE, 1920 Nos. 3 and 4

CHLORINATION BY MIXED CARBON MONOXIDE AND CHLORINE

By Francis P. Venable and D. H. Jackson

This investigation was undertaken to see if a mixture of carbon monoxide and chlorine could not be substituted for carbonyl chloride in certain chlorinations. It may be worth while to draw attention to this reaction as the use of phosgene in the industries has been suggested, but the dangers connected with its shipment and use may be prohibitive.

Chlorination with joint action of some reducing agent has been practiced for a long time. At first carbon and chlorine were used by d'Oerstedt and many others. The carbon has been replaced with carbon tetrachloride by Demarçay[1] and Camboulives[2]; with carbon plus carbon monoxide by Ribau[3]; with sulfur by Matignon and Bourion[4]; with sulfur monochloride by Bourion[5]; and with carbonyl chloride by Chauvenet[6]. The experiments detailed below show that carbon monoxide with admixed carbon reacts readily in conjunction with chlorine, and in the references given it will be noted that both carbon tetrachloride and carbonyl chloride react when used alone. Carbonyl chloride, especially, reduces and chlorinates with ease oxides, sulphides and some very stable salts.

The experiments reported here were necessarily limited in number but may be extended at some more convenient time. The substance to be acted on was placed in a boat in a hard glass tube and the mixed

[1] *Compt. Rend.*, **104** (1887), 111.
[2] *Compt. Rend.*, **150** (1910), 175, 221.
[3] *Bull. Soc. Chim.*, **39** (1883), 14.
[4] *Compt. Rend.*, **138** (1904), 631, 760.
[5] *Compt. Rend.*, **145** (1907), 62.
[6] *Compt. Rend.*, **152** (1911), 87, 1250.

gases passed over it. The heating was done by an electric sleeve and the temperature up to 550° recorded by an accurate thermometer inserted in the tube with the bulb by the side of the boat. No corrections were made for the portion of the thermometer stem exposed beyond the tube, as such accuracy was not necessary. For temperatures above 550° ammeter readings, which had been standardized, were used. Two or three grams of the powdered samples were taken for each experiment.

Expt. 1. Litharge was heated quickly up to 300°, then at the rate of 5° to the minute. At about 345° it began to turn black and at 360° it had changed entirely to black. At 390° the color began to lighten and at 400° it was pure white. No further change was observed up to 550°. The white powder (lead chloride) was entirely dissolved by water. This experiment is especially instructive as the two steps in the reaction, first a reduction followed by chlorination, are quite distinct.

Expt. 2. The green oxide of uranium (U_3O_8) was treated in the same way and also showed the antecedent reduction changing at first into the black oxide (U_3O_5) at 450° and forming the chloride at 500°.

In the remaining experiments the two steps, reduction and chlorination, if they occurred separately could not be distinguished. Chromic oxide began to chlorinate at 625°, stannic oxide at 400°, alumina at 450°, manganese dioxide at 460°, calcium oxide at 630°, magnesia at 475°, ferric oxide at 460° and zirconia at 480°.

The mixture of gases used in these experiments probably contained an excess of carbon monoxide. For a few of the substances the reaction was repeated with a considerable excess of chlorine. Under these conditions the chlorination temperature for ferric oxide was lowered from 460° to 370° and for zirconia from 480° to 425°.

A comparative table of the approximate chlorination temperatures follows:

Substances	CCl_4	$CCl_4 + Cl_2$	$COCl_2$	$CO + Cl_2$	$COCl_2 + Cl_2$
TiO_2	430°		450°		
ZrO_2	430°	300° +	400°	480°	425°
ThO_2	420°		650°		
SnO_2	400°		400°	400°	
BaO	330°		500°		
MgO	390°		450°	475°	
ZnO	400°		450°		
Al_2O_3	390°		400°	450°	

Substances	CCl_4	$CCl_4 + Cl_2$		$CO + Cl_2$	$COCl_2 + Cl_2$
Fe_2O_3	245°	below 300°	350°	460°	370°
Cr_2O_3	580°		600°	625°	
MnO_2	400°		450°	460°	
NiO	550°		550°		
U_3O_8	360°		450°	500°	
Ce_2O_3	350°		600°		
La_2O_3	330°		600°		

Certain facts may be stated with regard to these reactions. First, they do not seem to take place in the case of compounds of silicon and boron. In many cases an antecedent reduction is noticed, but this takes place at a much lower temperature than that at which the reducing agent is usually effective. The combination of the reducing agent with chlorine as carbon tetrachloride or carbonyl chloride increases the activity. It may be that these compounds act only after dissociation, but then it is difficult to explain the still greater activity in the presence of excess of chlorine. This increased activity may be explained on the assumption that in certain cases the reduction is a surface action which slows down or ceases unless the product is removed. The rapid removal of this by the chlorine speeds up the reaction.

Our experiments show that mixtures of carbon monoxide and chlorine, the latter preferably in excess, may be very conveniently used for bringing about industrial chlorinations.

CHAPEL HILL, N. C.

A RAPID VOLUMETRIC METHOD FOR THE DETERMINATION OF ARSENIC IN ARSENATES

By James M. Bell

The rapid and exact method of Mohr for the determination of arsenious acid depends on the reaction:

$$As_2O_3 + 2H_2O + 2I \rightleftarrows As_2O_5 + 4HI$$

This reaction is reversible, going toward the right when one of the reaction products is removed as it is formed. Two methods have been proposed for the removal of hydrogen iodide, both based upon the reduction of the hydrogen-ion concentration. In the first of these methods, the solution is kept neutral or slightly alkaline by means of a large excess of sodium bicarbonate, added just previously to the titration with iodine solution. This method gives satisfactory results. The evolution of carbon dioxide may be avoided by the use of disodium phosphate instead of sodium bicarbonate, as was proposed by Washburn.[1] Advantage is here taken of the slight hydrogen-ion concentration in solution containing both disodium phosphate and monosodium phosphate. This method also gives excellent results.

A volumetric method of equal accuracy for arsenates was sought in connection with a study of the arsenates, the results of which will appear in a later paper. The volumetric method of the Association of Official Chemists[2] depends on the reversal of the reaction as written above, followed by titration with iodine solution. This is effected by treating the arsenate with rather concentrated sulphuric acid and potassium iodide and by removal of one of the constituents on the left of the equation, iodine. Long continued boiling follows until all the iodine has been volatilized. The solution is then neutralized and the arsenious oxide titrated against iodine solution in the presence of sodium bicarbonate. The removal of iodine by long continued boiling, sometimes until fumes of SO_3 are evolved requires careful watching and may also involve the removal by volatilization of arsenious iodide. A yellow deposit of this substance frequently appears around the neck of the flask and it is probable that some of it may have escaped. This loss is indicated by low results obtained with known samples and by the failure to obtain duplicate results.

[1] Jour. Am. Chem. Soc., **30**, 31 (1908).
[2] Report of the Committee on Editing Tentative and Official Methods of Analysis (1916), p. 67.

A better method of eliminating free iodine was sought. The following procedure was finally employed: To 25 c.c. of a solution containing about 0.1 gram of As_2O_5 were added one to two grams of potassium iodide and after solution 5 c.c. of conc. hydrocloric acid. This mixture is then boiled and as free iodine appears a dilute solution of sodium sulphite is added from a burette to destroy the yellow color of the solution. Sodium thiosulphate cannot be used, as it is decomposed by hot acid solutions with the liberation of free sulphur. Boiling is continued for a few minutes after the last appearance of iodine in order to remove any excess of sulphite, as SO_2, which may have been used. The flask is then cooled in cold water and caustic soda solution is dropped in from a pipette until litmus paper turns blue. Dilute hydrochloric acid is added drop by drop until the litmus paper just turns red. Crystals of disodium phosphate, 3 to 5 grams, are now added, turning the litmus blue, and titration against N/10 iodine solution follows immediately.

As a test of the accuracy of the above method, a quantity of As_2O_3 was dissolved in dilute hydrochloric acid solution; the solution was made alkaline and then faintly acid; an excess of disodium phosphate was added and titration against iodine solution followed immediately. After this titration, the solution containing arsenic only as As_2O_5 was reduced by the method above described and the titration repeated. The results will be seen to agree within the experimental error:

	No. 1	No. 2	No. 3	No. 4
First titration	17.55cc	17.80cc	17.79cc	17.76cc
Second titration	17.58cc	17.79cc	17.76cc	17.74cc

The quantities of arsenic taken in each of the trials was not the same, so that no comparison should be made of the different samples with each other. The agreement between the two titrations for the same quantity of arsenic shows that the proposed method is as accurate as the Mohr method for arsenious oxide. The time required, after the sample is in solution, is from 15 to 20 minutes for reduction to the arsenious condition and subsequent neutralization and titration against the standard iodine solution.

CHAPEL HILL, N. C.

THE LAND OF FERNS

THE HABITATS AND DISTRIBUTION OF THE FERNWORTS OF FLORIDA

By John K. Small

Plates 24-28

Florida has been called the "land of flowers." Even more properly could it be called "the land of ferns." While its pinelands and prairies are themselves not without their own peculiar species, its woods, hammocks, marshes, swamps, and sand-dunes, so abound in fern plants, often in such remarkable luxuriance, that Florida becomes the Fern State, par excellence, among all the States of the Union.

The pinelands[1] are the forests of pine trees, apparently the permanent tree covering replacing the broad-leaved growth or hammocks of former ages, at least in some parts of the state.

The prairies[2] are flat, more or less extensive, usually damp, treeless areas, mostly in the peninsula.

The woods[3] are the broad-leaved forests, usually in the hilly or rolling parts, especially of northern Florida.

The hammocks[4] are dense growths of broad-leaved trees, in a pine-forest or on a prairie, mostly in peninsular Florida. The use of this word is confined to Florida and adjacent States. It was formerly confused with the word hummock. The word is probably of Indian origin. Lime-sinks which are usually conspicuous ferneries, are commonly in hammocks, and are included here.

The marshes[5] are wet prairies. They are common throughout the peninsula. Depressions in the prairies often form ponds.

The swamps[6] are wet woods. They are common throughout the state and are often along or near streams.

The sand-dunes[7] are undulating or hilly areas of siliceous or cal-

[1] Their characteristic fernwort genera are few: *Anemia, Pycnadoria, Pteris, Sphenomeris, Lycopodium, Selaginella.*

[2] Their characteristic genera are few: *Blechnum, Onoclea, Lycopodium.*

[3] Their characteristic genera are few: *Botrychium, Ophioglossum, Lygodium, Pteris, Adiantum, Asplenium, Athyrium, Dryopteris, Polystichum, Selaginella.*

[4] Their characteristic genera are numerous: *Ophioglossum, Cheiroglossa, Trichomanes, Actinostachys, Stenochlaena, Polypodium, Phlebodium, Campyloneurum, Phymatodes, Vittaria, Paltonium, Adiantum, Hypolepis, Cheilanthes, Asplenium, Tectaria, Dryopteris, Nephrolepis, Selaginella, Psilotum.*

[5] Their characteristic genera are several: *Osmunda, Ceratopteris, Acrostichum, Blechnum, Anchistea, Lorinseria, Dryopteris, Azolla, Lycopodium, Selaginella, Isoetes.*

[6] Their characteristic genera are: *Osmunda, Actinostachys, Acrostichum, Anchistea, Lorinseria, Blechnum, Dryopteris, Meniscium, Nephrolepis, Onoclea, Lycopodium, Selaginella, Psilotum.*

[7] Their characteristic genera are few: *Pteris, Cheilanthes, Selaginella.*

PLATE 24

In Timms' Hammock near Princeton, Fla. Showing the simple-leaved or nearly simple-leaved halberd-fern (*Tectaria heracleifolia*) and the much compound maidenhair (*Adiantum tenerum*). Both of these species are rock-lovers and are here growing on a perpendicular face of oölitic limestone.

careous sand, active along the coast, stationary back of the coastal lagoons and in the interior. Shell-mounds or kitchen-middens are usually built on or near dunes. The so-called "scrub," which comprises extensive areas of white sand supporting a characteristic plant association, is included here.

In these various areas are found about one-third of the different kinds of ferns and fern-allies growing naturally in all America north of Mexico; and the variety in habit and leaf-form of these far exceeds that exhibited by the ferns of any other part of either the United States or Canada. In Florida more than one hundred ferns and fern-allies, both simple and complex, from very small to gigantic, grow either as native or as naturalized plants.

There are ferns in nearly every part of the State, but only the more marked areas of distribution will be referred to on the following pages, to-wit: northern Florida is the long horizontal (east-west) axis of the State, while peninsular Florida is the long perpendicular (north-south) axis. The Florida Keys[8] are the islands of the Florida reef off the southern coast. The Everglade Keys are islands in the southern part of the Everglades. The Florida Keys and Everglade Keys are islands of rock. The upper series of Florida Keys are of coral limestone and are clothed with hammock. The Everglade Keys and the lower series of Florida Keys are of öolitic limestone and are clothed with both hammock and pine forest. The lime-sink region is an area in the northwestern part of the peninsula, which is surrounded by other phytogeographic regions. It comprises mostly rolling sandy pine woods with depressions or sinks, but only few streams. However, near the rivers there are many large springs.

The different kinds of fernworts may be grouped thus: (a) naturalized exotic species, (b) endemic species, (c) species typically of a more northern distribution, and (d) species typically of more southern distribution, and consequently tropical.

There are, apparently, only three naturalized fernworts. These are:

Pteridium aquilinum (Bracken)
Dryopteris setigera (Wood-fern)
Marsilea vestita (Pepperwort)

[8] Key (Spanish cayo, English cay) primarily applied to islands along the coast in and near Spanish-speaking countries, largely replaces the use of the word "island," particularly in southern Florida, and by the inhabitants is applied to islands in the Everglades as well as to the islands of the coast and reef of Florida.

Little is known concerning a rare bracken, *Pycnadoria longifolia*, within our range, and it may yet prove to be a native plant. There seems to be no good reason why it should not be native, for it occurs plentifully on the islands on the other side of the Gulf Stream. The other exotic has found such favorable habitats and grows in such a natural manner that it is difficult to realize that it is not a native plant. In fact, never has a satisfactory explanation been offered as to how the large wood-fern, *Dryopteris setigera*, did gain a foothold in these apparently natural habitats. Of course, it may be that its spores were primarily carried there by winds from cultivated plants and thus lodged in favorable habitats. But the true manner of its introduction may remain a mystery forever. The pepperwort, *Marsilea vestita*, is native west of the Mississippi River. It seems to have been brought into Florida through the agency of the railroads, and as far as we know it has not been found far away from the lines of traffic.

Two additional species, a bracken, *Pycnadoria cretica*, and a clubmoss, *Lycopodium cernuum*, are sometimes considered naturalized plants, but there has never been good evidence advanced to support that theory.

There are seven endemic species in Florida. These are:

Asplenium biscayneanum (Spleenwort)
Asplenium Curtissii
Tectara Amesiana (Halberd-fern)
Selaginella funiformis (Resurrection-plant)
Selaginella humifusa
Isoetes Chapmanii (Quillwort)
Isoetes alata

The first-mentioned spleenwort grows in only one hammock—a hammock on the Everglade Keys, in the southern end of the Everglades, while the second one is found in hammocks in the lime-sink region of the northern part of the peninsula. The *Tectaria* is known only in the hammocks of the Everglade Keys. The first-cited species of *Selaginella* occurs in peninsular Florida, while the second one has been found in northern Florida, as well as in the peninsula. The first-mentioned quillwort has been found only in western Florida, while the second one is known to occur only in the Gulf Hammock region. This region is a rather narrow strip along the upper western coast of the peninsula with limestone near the surface or cropping out. The coast line differs from that farther south in being devoid of

PLATE 25

On Robert's Island, Everglades, west of Little River Prairie. The most abundant fern in this photograph is the Boston-fern (*Nephrolepis exaltata*). It is accompanied by the Swamp-bracken (*Blechnum serrulatum*) which may be distinguished by the leaves with the longer and separated leaflets. The Swamp-bracken is rarely epiphytic, but the Boston-fern commonly inhabits both palms and deciduous-leaved trees.

islands. The very gradually sloping ocean bottom acts as a barrier against the approach of high waves from the Gulf of Mexico. The long-leaf pine is the most abundant tree, but there are many low hammocks besides the great Gulf Hammock of Levy County—whence the name for the region.

The vast majority of the species comprising this fern flora are native plants that occur also outside the state, either in the eastern United States or in tropical America. They fall into two groups: the one composed of northern elements, the other of southern elements. With very few exceptions the plants are fibrous-rooted. The species of the genera *Botrychium, Ophioglossum,* and *Cheiroglossa* are fleshy-rooted and doubtless all represent mycorrhiza forms.

The northern elements comprise about one-third of the species. They are not, however, all strictly typical of decidedly northern latitudes. On the one hand, some only extend northward as far as southern Georgia, and others are merely in the coastal plain of the Gulf of Mexico, while on the other hand a few of the species that are naturally included among the northern ferns are found in the American tropics. Following is a list of the species:

Botrychium obliquum (Grape-fern)
Botrychium virginianum (Rattlesnake-fern)
Ophioglossum vulgare (Adder's-tongue)
Ophioglossum crotalophoroides
Trichomanes Boschianum (Filmy-fern)
Osmunda regalis (Royal-fern)
Osmunda cinnamomea (Cinnamon-fern)
Lygodium palmatum (Climbing-fern)
Pteris aquilina (Brake)
Adiantum Capillus-Veneris (Venus'-hair fern)
Pellaea atropurpurea (Cliff-brake)
Anchistea virginica (Chain-fern)
Lorinceria areolata (Chain-fern)
Asplenium platyneuron (Spleenwort)
Asplenium resiliens
Athyrium Filix-foemina (Lady-fern)
Dryopteris Thelypteris (Shield-fern)
Dryopteris floridana (Wood-fern)
Dryopteris hexagonoptera (Beech-fern)
Polystichum acrostichoides (Christmas-fern)
Onoclea sensibilis (Sensitive-fern)
Marsilea vestita (Pepperwort)
Azolla caroliniana (Watermoss)
Lycopodium alopecuroides (Clubmoss)

Lycopodium prostratum
Lycopodium adpressum
Lycopodium carolinianum
Selaginella apus (Little-clubmoss)
Selaginella ludoviciana
Selaginella acanthonota (Resurrection-plant)
Selaginella arenicola
Isoetes flaccida (Quillwort)

These ferns occupy, for the most part, temperate and sub-tropical Florida.[9] The plants are predominantly terrestial. Some kinds, however, are aquatics; others are amphibious. Many kinds prefer as a habitat what we commonly call soil, others grow best on exposed rock, while a few seem to thrive luxuriantly in "peat."

The lowland kinds reach Florida along the Atlantic Coastal Plain, while the highland species extend southward from the mountains or from the Piedmont region along the hills and ridges and through the river-valleys of western Georgia and eastern Alabama. The typically lowland kinds, the majority of the species of the above list, often range far southward in the peninsula, while the ranges of the highland species generally end in northern Florida or in the upper part of the peninsula, for example: *Athyrium Filix-foemina, Dryopteris hexagonoptera, Polystichum acrostichoides.*

The tropical elements, comprising, as they do, about two-thirds of the species, furnish the more varied and consequently the more interesting fern-plants of our range. They are represented by:

Ophioglossum tenerum (Adder's-tongue)
Cheiroglossa palmata (Hand-fern)
Trichomanes lineolatum (Filmy-fern)
Trichomanes punctatum
Trichomanes Kraussii
Actinostachys Germani (Curly-grass)
Anemia adiantifolia (Flowering-fern)
Ceratopteris pteridoides (Floating-fern)
Ceratopteris deltoidea
Stenochlaena Kunzeana (Holly-fern)
Acrostichum aureum (Leather-fern)
Acrostichum excelsum
Polypodium Plumula (Polypody)
Polypodium pectinatum
Polypodium polypodiodes (Resurrection-fern)

[9] Includes particularly all the state, except the Everglade Keys, the Cape Sable region, and the Florida Reef. The ferns have been considered in "Ferns of Tropical Florida," i-ix, 1-80, 1918, and "Ferns of Royal Palm Hammock," i-vii, 1-38, 1918, and incidentally in papers published in the journal of The New York Botanical Garden from 1904 to 1920.

PLATE 26

In a fern grotto with walls of limestone, near Pinola. Four kinds of ferns may be seen—three spleenworts and one halberd fern (*Tectaria heracleifolia*). The lace-like spleenwort at the top of the print is *Asplenium Curtissii*, one of the endemic species. The narrow-leaved spleenwort is *Asplenium heterochroum*, while the lanceolate-leaved one at the bottom of the cliff is *Asplenium verecundum*.

Phlebodium aureum (Serpent-fern)
Campyloneurum angustifolium (Strap-fern)
Campyloneurum costatum
Campyloneurum latum
Campyloneurum Phyllitidis
Phymatodes exiguum (Vine-fern)
Vittaria lineata (Shoestring-fern)
Paltonium lanceolatum (Tip-fern)
Pycnadoria pinetorum (Bracken)
Pteris caudata (Brake)
Adiantum tenerum (Maidenhair-fern)
Adiantum melanoleucum
Hypolepis repens (Beaded-fern)
Cheilanthes microphylla (Lip-fern)
Blechnum serrulatum (Swamp-bracken)
Blechnum occidentale
Asplenium serratum (Spleenwort)
Asplenium heterochroum
Asplenium abscissum
Asplenium dentatum
Asplenium erosum
Asplenium verecundum
Asplenium Curtissii
Asplenium cristatum
Tectaria heracleifolia (Halberd-fern)
Tectaria coriandrifolia
Tectaria minima
Tectaria Amesiana
Meniscium reticulatum (Everglade wood-fern)
Meniscium serratum
Dryopteris panamensis (Shield-fern)
Dryopteris stipularis
Dryopteris normalis
Dryopteris augescens
Dryopteris ampla
Dryopteris gonglyodes
Dryopteris parasitica
Dryopteris radicans
Dryopteris tetragona
Nephrolepis exaltata (Boston-fern)[1]
Nephrolepis biserrata (Sword-fern)[1]
Sphenomeris clavata
Lycopodium cernum (Clubmoss)
Psilotum nudum (Brushmoss)

These tropical ferns, nearly all of which are hammock plants and

[1] These common names are used interchangeably.

grow for the most part on trees, in humus, or on exposed limestone, are largely confined to three well-defined areas. Two of these constitute "tropical Florida"—that is to say, the Florida Keys and the Everglade Keys. The other area is that lime-sink region in the northwestern part of the peninsula, mentioned above and to be referred to more fully further on.

The Florida Keys consist of a chain of low islands built upon the Florida Reef mainly south of the peninsula. All of them are remnants of what were evidently larger islands in past ages.[10] They are really situated in the waters of the Gulf Stream, and extend from the Atlantic Ocean on the northeast into the Gulf of Mexico on the southwest. They are naturally divided into two groups: those of the upper or more northern group, which are of coral-rock, and those of the lower or more southern group, which are of limestone. All the islands are clothed with tropical hammock, except portions of a few and here they are either partly heath-like or partly covered with pine. These hammocks and pinelands harbor but ten different kinds of native ferns. But of these, one only (*Paltonium lanceolatum*) has not yet been discovered on the Florida mainland.

The Upper Keys are for the most part long and narrow ridges of coral-rock and are clothed with evergreen hardwood forests which harbor the one kind of fern not yet known to occur on the Everglade Keys. The Lower Keys are more spread out, more even, and rather less elevated above the sea. They are clothed both with hardwood forests and, in the case of a half-dozen islands, with pine woods, at least in part. The Lower Keys have as yet yielded no ferns not already known on the Everglade Keys. In fact, the Florida Keys have a much smaller fern flora than the Everglade Keys. Only about one-fifth of the species of the Everglade Keys have been found there. No doubt in their past the fern flora was larger than it is now. It may have rivaled or excelled that of the Everglade Keys, for the Florida Keys consist of two areas of different ages, coral and limestone; but this region has been for a long time decidedly on the wane as regards area, and doubtless also vegetation.

In addition to the leaching process of erosion that has reduced the surface of the Everglade Keys, the Florida Keys have had the mechanical and chemical action of the sea to contend with and the evi-

[10] This statement refers to the islands composed of rock. The mud flats and islands covered with mangrove are evidently, as a rule, increasing in size, especially in sheltered places, but they scarcely figure in the matter of ferns. They are destitute of ferns, unless an occasional *Acrostichum aureum* got a foothold there.

In a fern grotto near Pinola (referred to on page 102). Here is where fourteen kinds of ferns grow copiously and intimately intermixed. Some thrive on rich humus, others on bare rock. Notice the plant of the needle-palm (*Rhaphidophyllum hystrix*) on the top of a boulder. The nearest relatives of this palm are in eastern Asia.

dence of reduction are not hard to observe. These islands have been worn down and washed away not only by the never-ceasing action of the sea, but also by the hurricanes of ages. This is quite evident. The rock surface, particularly in the case of the Lower Keys whose limestone corresponds to that of the Everglade Keys, is polished off and plate-like, instead of merely leached out and honeycombed. What the former fernworts consisted of we cannot even imagine, but we are safe in assuming that the list was more extensive than that which we are able to record there now.

The Everglade Keys, the second tropical area—a phytogeographic region isolated in the Everglades—comprise a curved series of limestone islands appearing on the surface about the neighborhood of the Miami River, trending southwest and disappearing in the southern end of the Everglades. The area is surrounded by the Everglades, except where a portion fronts on Bay Biscayne or its lagoons.

As on the Florida Keys, the native flora of the Everglade Keys consists almost wholly of tropical plants. Pineland predominates in extent of area today; but the few hammocks—evidently themselves remnants of a once dominant and magnificent forest—still harbor nearly fifty kinds of our tropical ferns. And among these are no naturalized exotic species, no typically northern species. The only northern ferns in the vicinity are those occurring where the Everglades and the limestone islands meet.

The number of ferns and fern-allies in this region is quite remarkable when we consider that the area involved comprises only a few hundred square miles, a mere fraction of the State's large area. Although variety in soil and other physical features is slight, this area harbors more than fifty per cent. of the fern flora of Florida.

An overwhelming majority of the species are typically tropical American. In addition to these, there are several cosmopolitan species and a few endemic ferns. The plants of nearly one-third of the species are epiphytic, living on the moisture of the air and getting solid food from the bark and small quantities of humus, while anchored on trees and prostrate logs. This condition doubtless makes up to some extent for the lack of variety in topography, climate, and soil.

The Everglade Keys consist of two main divisions, the Biscayne pineland[11] and the Long Key pineland. The former group is made

[11] These two groups of islands are separated from each other by a distance of three miles. The intervening Everglades contain a number of sloughs which represent the upper reaches of an unmapped river that flows southward and empties into the Bay of Florida. The larger or eastern group of islands takes its name from Bay Biscayne which washes the shores of one of the islands for a distance of about fifteen miles. The smaller group takes its name from Long Key, the largest island lying west of the sloughs referred to above.

up of about a dozen larger islands, which are mostly bounded by the Everglades on two sides and separated from each other by narrow channel-like intersecting prairies. The Long Key group has a much smaller area than the Biscayne pineland. It consists of about five larger islands and a few smaller ones. Both groups are of limestone, and they are slightly elevated above the Everglades. The rock is rather porous and the softer spots of the almost universally exposed surface have been eroded, mostly by leaching out, so as to form a surface honeycombed with all sizes of cavities having very ragged and sharp edges. These limestone islands are almost completely forested with the Caribean-pine (*Pinus caribaea*) which grows nearly everywhere on the exposed rock. However, the pine-woods, or pinelands, are interrupted here and there by hammocks or areas of hardwood shrubs and trees, some areas small and some much larger, although all taken together these comprise but a very small percentage of the region under consideration. The hammocks may be divided into two groups; first, the high pineland hammocks which are islands or colonies of hardwood trees in the pine-woods. They are dry except for the water contained in deep lime-sinks and in the humid air. They number about a score. Second, are the low pineland hammocks, indefinite in number and situated along the boundary line of the pinelands and the Everglades proper and prairies. These are usually high and dry towards the pine-woods and low and wet along the Everglades or prairies.

The ratio of pineland ferns to hammock ferns seems astonishingly small. There are only three kinds of ferns that may be considered naturally pineland plants. Even two of these ferns will spring up in clearings in hammocks which have been partly destroyed either by nature or by man. The other forty-eight species are hammock plants. Their habit ranges from the stiffest to the most graceful and their structure from the coarsest to the most delicate. The pineland species are strictly terrestrial in habit. The hammock kinds are to a great extent epiphytic.

The hammocks of the Biscayne pineland are rich repositories of ferns. The trees are nearly all evergreen. More abundant are: pigeon-plum (*Coccolobis*), devil's claws (*Pisonia*), blolly (*Torrubia*), cherry (*Laurocerasus*), wild-tamarind (*Lysiloma*), Jamaica-dogwood (*Ichthyomethia*), coral-bean (*Erythrina*), torch-wood (*Amyris*), bitterwood (*Simarouba*), gumbo-limbo (*Elaphrium*), Guiana-plum

On Hammer Key, midway between Cape Sable and Royal Palm Hammock. The plant here illustrated is a close second to whatever species might be considered the oddest fern in Florida. The plants are here shown in the dry weather state. The leaflets are rolled up in such a way as to give the pendant leaves, which vary from one to three feet in length, the aspect of strings of beads. This plant is a form of the tropical polypody, *Polypodium plumula*.

(*Drypetes*), soapberry (*Sapindus*), butter-bough (*Exothea*), wild-coffee (*Colubrina*), lancewood (*Ocotea*), stopper (*Eugenia*), and many others, all growing closely associated to make the hammocks.

Nearly all the kinds of ferns of tropical Florida may be found in them. The well-like lime-sinks, the hammock floor, and the trunks and limbs of rough-barked trees are the habitats of the many species, each and all usually forming ferneries of indescribable beauty. They can be appreciated by the eye alone; even the camera falls far short of doing them justice. In some places the deep well-like sinks have their sides completely covered with mats of iridescent filmy-ferns (*Trichomanes*) to the exclusion of all other vegetation, while nearby tree-trunks and logs are completely covered with another kind of filmy-fern. In other sinks the small halberd-fern (*Tectaria*) predominates, while in still others we find the honeycombed rock sides adorned with various ferns, filmies (*Trichomanes*), maidenhair (*Adiantum*), halberd-fern (*Tectaria*), wood-fern (*Dryopteris*), and spleenwort (*Asplenium*), not to mention the rarer holly-fern (*Stenochlaena*), which is one of the few climbing ferns of Florida. The hammock floor is another kind of fernery. There the strap-fern, various wood-ferns, maidenhair, spleenworts, sword-fern, and large halberd-fern, comprise the more conspicuous kinds. One species of wood-fern (*Dryopteris ampla*) is, at the same time, the most conspicuous and most elegant. It sometimes has an erect stem a foot and a half high and elegant lace-like leaves with a spread of a dozen feet! In these remarkable hammocks there are ferns everywhere, ferns underground, ferns on the ground, and ferns in the air. The trunks and limbs of rough-barked trees are actually clothed with masses of ferns, as well as with orchids, and other plants. The resurrection-fern (*Polypodium*), the strap-fern (*Campyloneurum*), and the Boston-fern (*Nephrolepsis*) are the most common epiphytic kinds, while the elegant vine-fern (*Phymatodes*) occurs plentifully in one hammock. Palmetto trees are often conspicuous ferneries. Below the crown of leaves and growing from among the old leaf-bases one often finds a collection of Boston-fern (*Nephrolepis*), shoestring-fern (*Vittaria*), hand-fern (*Cheiroglossa*), and serpent-fern (*Phlebodium*).

In passing, before taking up the additional tropical locality, it may be of interest to mention a kind of half-way station where a few tropical kinds of ferns have found congenial conditions, and flourish. It is the magnificent hammock that clothes the eastern shores of Lake

Okeechobee. Here vegetation is protected by the tempering of the westerly winds, that blow across the lake in winter. As a consequence the Boston-fern (*Nephrolepis*) and the strap-fern (*Campyloneurum*), as well as some epiphytic orchids, are abundant.

The third tropical fern area—and the one by far most difficult to understand or to interpret satisfactorily—is that district several hundred miles north of the Everglade Keys previously referred to, the lime-sink region in the northwestern part of the peninsula. Here the hammock is composed of trees not tropical, but characteristic of more northern warm temperate regions. The trees are mostly deciduous-leaved. There one finds iron-wood (*Carpinus*), oak (*Quercus*), elm (*Ulmus*), sugarberry (*Celtis*), mulberry (*Morus*), sweet-gum (*Liquidambar*), ash-leaved maple (*Negundo*), maple (*Acer*), and flowering dogwood (*Cynoxylon*). The boulders, sinks, chasms, cañons, caves, and cliffs hidden in these hammocks support a growth of ferns, even if of a fewer number and of less variety, yet, just as tropical, both in character and in kind, as do the lime-sinks of the Everglade Keys. There is one striking difference, it is true. This is the absence of the epiphytic kinds so common to the more southern area. The resurrection-fern (*Polypodium polypodioides*) is the only truly epiphytic kind. Following is a list of the species found in the largest known grotto:

Polypodium polypodioides (Resurrection-fern)
Polypodium Plumula (Polypody)
Polypodium pectinatum
Pteris cretica (Bracken)
Adiantum tenerum (Maindenhair-fern)
Asplenium abscissum (Spleenwort)
Asplenium Curtissii
Asplenium heterochroum
Asplenium platyneuron
Asplenium verecundum
Tectaria heracleifolia (Halberd-fern)
Dryopteris floridana (Wood-fern)
Dryopteris normalis (Shield-fern)
Dryopteris reptans

These species, or the related types in the case of the endemic *Asplenium Curtissii*, are of general tropical distribution. The plants are evergreen and have no apparent resting period during the year.

Such a copious growth of ferns is rarely seen anywhere else in Florida. Boulders and cliffs are often entirely hidden from view by dense masses of the various ferns growing intimately mixed. On other over-

hanging rocks with rather smooth faces the plants are often scattered. Most of the kinds grow not only on the perpendicular faces of the rocks, but also on the top of boulders and all more or less horizontal surfaces. The masses of leaves of all sizes and kinds of ferns often completely hide numerous pitfalls of various sizes and ranging from a few feet to twelve feet deep. Walking is rendered exceedingly dangerous from these treacherous pitfalls alone, not to mention the soft and crumbling edges of cliffs and ledges.[12]

Among the tropical ferns that do not comply with our rule of these three tropical phytogeographic areas, are the amphibious leather-ferns (*Acrostichum*), which extend northward along the coastal strip or through the Everglades up into the Lake region, the floating-ferns (*Ceratopteris*) which are scattered through the peninsula up into the Lake region, and such epiphytes as the hand-fern (*Cheiroglossa*), the serpent-fern (*Phlebodium*), the vine-fern (*Phymatodes*), the shoestring fern (*Vittaria*), two species of strap-fern (*Campyloneurum*), and the sword-fern (*Nephrolepis*).

The exception in the case of the epiphytes, however, is easily accounted for. The soil or rock conditions in the country lying between southern Florida and the northern part of the peninsula are wanting, but whenever the conditions of hammocks in this intervening territory are favorable, for example, the hammock on the eastern shore of Okeechobee, these epiphytes, finding congenial conditions, take hold and thrive.

There are nine kinds of ferns common to the Everglade Keys and to the lime-sink region. They are of tropical origin. There are forty-two species growing on the Everglade Keys not yet found in the lime-sink region, and five species have been collected in the lime-sink region not yet met with on the Everglade Keys.

Travelers and botanists observed and perhaps collected specimens of ferns in Florida before the beginning of the Eighteenth century. Then during the earlier part of the last century, further collections were made in many localities, and about the middle of that century nearly fifty species of ferns were known to grow wild in the entire state. During the eighth and ninth decades of the last century and

[12] For more detailed accounts of these fern grottoes see A. H. Curtiss, Plant World 5: 68-70, 1902, and R. M. Harper, American Fern Journal 6: 68-81, 1916.

the first decade of the present century, however, during which periods collectors carried on botanical explorations in the less-known parts of the state, the list of Florida ferns was increased by more than fifty additional species. So that now, as already stated, we know that in this state alone there are growing, without cultivation, over one hundred different kinds of ferns and fern-allies.

THE NEW YORK BOTANICAL GARDEN.

THE REGIONAL GEOGRAPHY OF SOUTH CAROLINA ILLUSTRATED BY CENSUS STATISTICS

By Roland M. Harper

Plate 29

In the *Journal of School Geography* (afterwards called the *Journal of Geography*) for January and March, 1898, there is a 14-page description of South Carolina by Prof. L. C. Glenn—a former resident of that state, and a North Carolinian by birth—which is a good example of what can be done by a careful observer with the proper geographical point of view, without reference to census reports or other previous literature.

The present paper supplements Prof. Glenn's by dividing the same state into natural regions and illustrating some of the contrasts between them by means of statistics, mostly taken from the 13th United States Census (1910). The main object of this study is to give readers an idea of the vast amount of geographical information that is buried in census reports and going to waste, as it were, for lack of geographers sufficiently interested in that kind of work to dig it out and put it together by regions. Most of the same kinds of ratios here worked out are indeed given in recent census reports for whole states, but as the average state is divisible into at least half a dozen regions, differing in all sorts of ways, the contrasts between them are pretty effectually concealed by the common practice of using state averages.

Description is here reduced to a minimum, to avoid unnecessary duplication of what has already been written by Professor Glenn and others. And in order to economize space only a few of the many possible kinds of statistics are used, but those few are believed to be among the most significant. By utilizing more of the census tables, and also by going back to earlier censuses, the length of this article could have been increased many times without sacrificing much of its geographical interest. Statistics could also have been obtained from other sources than census reports; for example, the relative areas of different soil texture classes from government soil surveys, and the relative abundance of different trees or other plants from the writer's field notes. But these lines have not yet been worked up with a degree of thoroughness at all comparable with a census, and they may therefore be left out of consideration at present.

Conditions in South Carolina are very favorable for showing certain fundamental relations between geology, or soil, and civilization. The state can be divided into seven or eight belts approximately parallel to the coast, each differing from its neighbors in geology, soil or topography (and incidentally in climate, though that gives no abrupt transitions and therefore does not help us much in drawing the regional boundaries), with corresponding differences in the density, racial composition and education of the population, the development of agriculture, etc. The counties, although rather large for statistical refinements (averaging about 709 square miles each in 1910) fit these belts very well, considering the fact that they were laid out with little regard to regional geography. This is not quite so true of census periods previous to the last, however, when some of the counties were larger, and that is one reason why the regional statistics given here are based on the last census only. (A few additional counties have been created since 1910, but those are of course ignored.)

The different belts or regions were well described by Maj. Harry Hammond, of Aiken County (1829-1916), one of the greatest geographers the South ever produced, in the 6th volume of the Tenth Census, and in still greater detail in his 734-page handbook of South Carolina, published about the same time (1883) by the state agricultural department.* The present writer, having visited most of the counties in South Carolina, has introduced some minor modifications, and the boundaries as now recognized are shown on the accompanying sketch map.[2]

The regions will be described very briefly, and the results of the statistical investigations then presented in a table, followed by appropriate comments.

The *Blue Ridge*, including the highest mountains in the state, with a maximum altitude of about 3,500 feet, occupies only a few hundred square miles in the extreme northwest, too small an area to figure at all in the statistical tables. It is therefore combined with the next region.

The *upper Piedmont region*, on account of its geographical position, is the highest, coolest, and most hilly part of the state, with the ex-

* Unfortunately the only leaf bearing the author's name, namely, that containing the preface and bibliography, was cut out of most copies of this monumental work by the publishers, on account of a slight misunderstanding; and the authorship is therefore sometimes credited to the then Commissioner of Agriculture by those who do not know the circumstances.

[2] The fall-line, or boundary between the Piedmont and sand-hills, is generalized from a geological map by Earle Sloan, in the 1907 Handbook of South Carolina.

ception of the Blue Ridge just mentioned. Its area is about 3,600 square miles. It is characterized by gneiss and other metamorphic rocks, which weather into red clayey loams and gray sandy loams of medium fertility. It has more water-power in proportion to its area than any of the regions lower down, and cotton manufacturing is a very important industry. The statistics used are based on the six northwesternmost counties, all of which have more whites than negroes (which cannot be said of any other six contiguous counties in the state).

The *lower Piedmont region* is similar geologically to the upper, except for having more granite, trap and slate. On account of being nearer the coast and less elevated the topography is a little smoother and there is less water-power than in the upper division (as could be brought out by means of certain census statistics if one wanted to take the trouble). The soil is apparently just a little more fertile on the average than that nearer the mountains. (Fertile soil and abundant water-power hardly ever characterize one and the same region.*) The area is about 6,500 square miles, approximately coextensive with eleven counties.

The boundary between the upper and lower Piedmont regions is a rather arbitrary one, for the most striking difference between them, and one not wholly accounted for by the rather small differences in natural environment, is in the racial composition of the population, which is brought out in the table. The cause of this marked difference is not altogether clear, but it is probably largely historical, though it may be partly fortuitous. The same distinction can be made very satisfactorily in the Piedmont region of Georgia, but not in North Carolina, perhaps on account of soil differences.

The innermost division of the coastal plain is the *sand-hills*, which extend all the way across the state,—except for being interrupted by river valleys—and a considerable distance into the two adjoining states. The area is irregular and not easy to measure, but is probably about 3,000 square miles. This is an elevated and very sandy region, as the name implies. It has an agreeable climate and pure water, and contains some well-known winter and spring resorts, such as Camden and Aiken. The soil is rather poor, but the counties used in preparing the table (Chesterfield, Kershaw and Lexington) all include parts of more fertile regions, so that the census statistics are not altogether

* See Journal of Forestry (Washington) **16**: 443, 1918.

typical. If it were possible to exclude the more fertile areas the figures would show greater contrast than they do.

The *upper pine belt* embraces considerable diversity, from high red hills to flat sandy pine woods and swamps, but there are all sorts of intermediate conditions, and it would be difficult to subdivide this region in any way that would give us significant statistics as long as the counties are as large as they are. The region covers about 14 counties and 11,000 square miles.

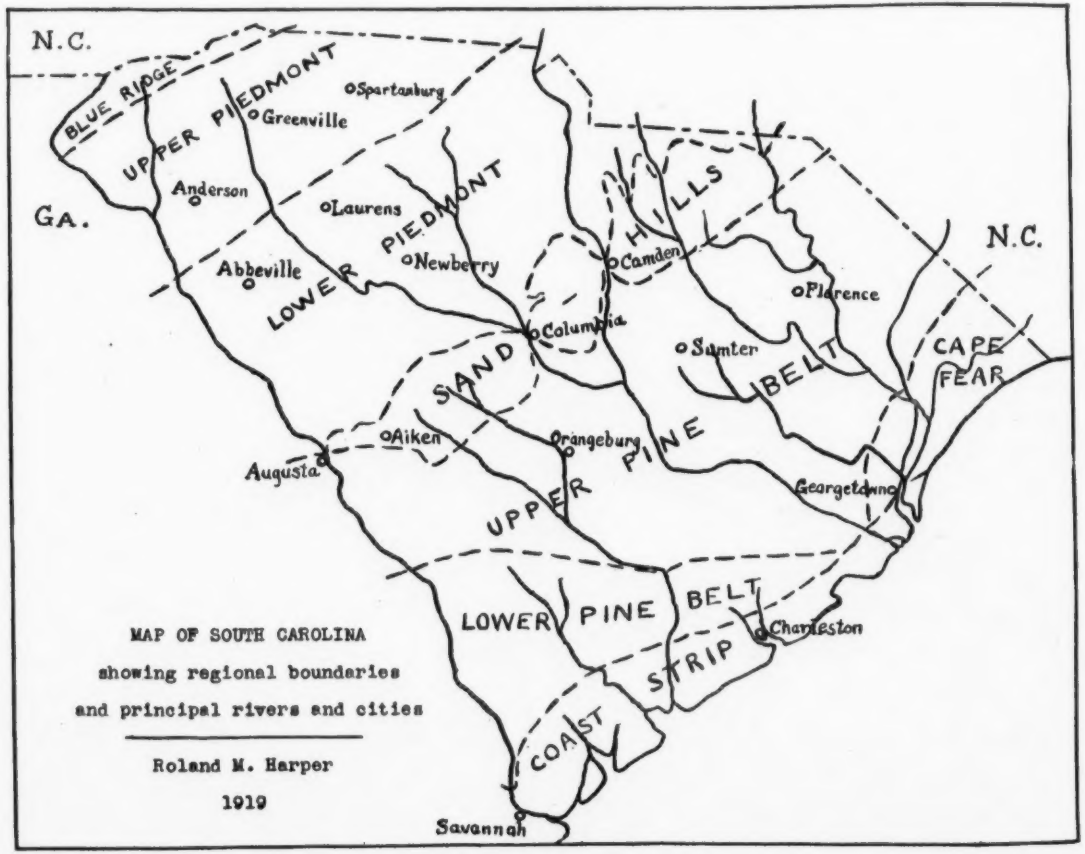
The *lower pine belt* differs from the preceding chiefly in having almost no red hills, more ponds, more sandy soil, and more long-leaf pine. It is approximately coextensive with Dorchester, Colleton and Hampton counties, and covers about 2,700 square miles.

The *Cape Fear pine-barren region* centers around Wilmington, N. C., and in South Carolina includes most of Horry County, about half of Georgetown (but not half its population), and perhaps part of Marion, or about 1,500 square miles. It is characterized by copious summer rain (nearly half the annual preciptation comes in the four warmest months), and the soils are sandy and pretty well leached of fertility. The statistics used to illustrate it are based on Horry County alone.

The *coast strip* includes the islands, marshes, and marly flats along the coast, mostly south of the Santee River. The soils are of various degrees of fertility, but mostly pretty well supplied with phosphorus, the raw rock or ore of which has been mined in several places for fertilizing purposes. Some of the richest soil is too swampy for profitable cultivation, however, especially since the competition of Louisiana practically put an end to the rice industry that once flourished here. The area is about 1,600 square miles of land, and the counties of Charleston and Beaufort are taken as typical.

The first table gives statistics of density, race, nativity and illiteracy of the population in each of seven regions, together with corresponding figures for the state as a whole at the last four censuses, this addition being for the purpose of illustrating certain general principles better and facilitating comparisons with other states that have been or will be studied in the same way. There is also a column for urban percentage, urban population being defined at the last two censuses as that living in cities and towns with over 2,500 inhabitants. (Previously a higher minimum was used, so that in order to get comparable figures one has to pick out the places having more than the

PLATE 29


N.C.
BLUE RIDGE
UPPER PIEDMONT
Spartanburg
Greenville
Anderson
GA.
Laurens
LOWER PIEDMONT
Newberry
Abbeville
HILLS
Camden
N.C.
Florence
Columbia
Sumter
SAND
BELT
CAPE
FEAR
Aiken
Orangeburg
PINE
Augusta
Georgetown
UPPER
LOWER PINE BELT
Charleston
STRIP
COAST
Savannah
MAP OF SOUTH CAROLINA
showing regional boundaries
and principal rivers and cities
Roland M. Harper
1919

specified number of inhabitants and add them together.) The illiteracy percentages are based on the number of persons over ten years old unable to read and write.

In both tables the highest numbers in each column are printed in heavy type and the lowest in italics, to help the reader pick out the extreme range of variation in South Carolina and also the salient features of each region as far as they are shown by the kinds of data here used.

The influence of racial demography is illustrated still further by putting at the bottom of both tables separate statistics for the twenty counties that have more than 40% of whites, and the 23 "blackest," with less than 40% white.

TABLE 1. POPULATION AND ILLITERACY

REGIONS, ETC.	Inhabitants per Square Mile	Percentage of total				Percent illiterate			
		Native White	Foreign White	Negro	Urban	Native White	Foreign White	Negro	Aggregate
Whole state, 1880	33.0	38.6	0.7	60.7	7.7	22.4	4.9	78.5	55.4
1890	38.2	39.8	0.5	59.7	10.5	18.1	6.3	64.1	44.9
1900	44.4	41.2	0.4	58.4	12.8	13.6	6.5	52.8	35.9
1910	49.7	44.4	0.4	55.2	14.8	10.3	6.8	38.7	25.7
Upper Piedmont	**78.1**	68.3	0.3	31.4	16.8	13.3	10.0	36.0	*20.3*
Lower Piedmont	53.6	39.6	0.2	60.2	11.7	7.6	7.8	39.6	26.4
Sand-hills	36.4	53.5	*0.1*	45.3	7.5	11.5	3.5	44.5	26.2
Upper pine belt	45.2	34.2	0.2	65.6	7.3	10.3	4.1	37.5	27.6
Lower pine belt	26.9	36.9	0.1	63.0	0	8.1	*0.1*	**49.8**	**34.3**
Cape Fear region	*22.5*	**75.1**	0.1	*24.7*	*0*	**18.7**	**16.0**	41.1	21.6
Coast Strip	74.0	*28.3*	**2.4**	**69.2**	**49.5**	*2.0*	6.1	*35.9*	25.2
20 whitest counties	57.0	56.7	0.3	42.9	15.6	12.3	7.6	37.1	22.8
23 blackest counties	43.8	31.9	0.5	67.6	14.0	6.8	6.3	39.7	28.7

The second table is devoted to agriculture, and gives for the whole state in 1900 and 1910, for each region, and for the same two groups of counties above outlined, the ratio of "improved land in farms" to total area (expressed as a percentage), the expenditure for fertilizers in the year preceding, per acre of improved land in the census year (in dollars and cents), the percentage of white farmers, the average num-

ber of improved acres managed by white and negro farmers, and the value of farm buildings, for both races separately and combined.

TABLE 2. AGRICULTURE

REGIONS, ETC.	Percentage of area improved	Fertilizer per acre	Percent of white farmers	Improved acres per farm		Value of buildings per farm		
				White	Negro	White	Negro	Aggregate
Whole state, 1900	29.6	0.78	45.0	50.1	26.6	304	67	173
1910	31.2	2.49	45.1	43.9	26.8	617	155	364
Upper Piedmont	**41.1**	1.77	68.0	31.9	26.9	536	**183**	**422**
Lower Piedmont	41.0	*1.63*	39.4	46.0	**31.0**	680	157	363
Sand-hills	25.6	2.36	62.0	38.7	27.0	453	126	337
Upper pine belt	32.9	**3.75**	36.8	52.1	26.8	726	156	365
Lower pine belt	20.2	1.94	42.4	58.5	21.8	570	141	324
Cape Fear pine-barrens	*11.9*	2.96	**81.7**	*26.7*	13.8	*271*	*104*	243
Coast strip	15.0	2.78	*8.1*	**100.0**	*12.4*	**1083**	122	*200*
20 whitest counties	33.8	2.45	58.0	37.1	28.4	556	169	393
23 blackest counties	29.2	2.62	32.8	55.4	25.8	720	146	335

The densest population is in the upper Piedmont region, where the most manufacturing is, but the coast strip is a close second, on account of containing the state's principal seaport, which includes nearly half the population of that strip. The other extreme is in the Cape Fear region, which has the poorest soil. The last named has the largest percentage of whites; while the coast strip has the most negroes and also the most foreigners, for more or less obvious reasons. The percentage of negroes and foreigners in the state as a whole has decreased in recent decades.

The aggregate illiteracy is least in the two regions that have the smallest proportion of negroes, and would probably be greatest in the coast strip but for the fact that nearly half the population of that region is urban and therefore has pretty good school facilities. Illiteracy among the native whites, curiously enough, is greatest where negroes are fewest, and vice versa, as may be seen not only from the highest and lowest figures in that column, but also from the statistics of the two divisions of the Piedmont, which, as already stated, are similar in natural features but differ widely in racial composition, and from the two groups of counties with different proportions of negroes.

If illiteracy is a safe criterion, the quality of the foreign-born population of South Carolina has deteriorated a little in recent decades, while the natives, both white and black, have made great progress. The foreigners are still a little superior to the native whites in that respect, however, except in the coast strip, where they are most numerous. (In the other regions they have probably never constituted as much as 1% of the population since there has been a census.) Nearly half the negroes in the lower pine belt were unable to read and write at the time of the last census, perhaps because that region had less than ten white people per square mile; not enough to maintain a very efficient system of rural schools. There is much less variation in illiteracy among the negroes in different regions than among the whites, which agrees very well with what we already know about that race.

Turning now to the agricultural statistics, the percentage of improved land depends largely on soil fertility, and is lowest in the poorest region, but in South Carolina some moderately fertile regions, like the coast strip, have large areas of swamp and marsh, which materially restricts the possible improved acreage. This may explain why the lower Piedmont region has a trifle less improved land than the upper, instead of more, as we might expect from the smoother topography, etc.

The expenditure for fertilizers depends partly on soil fertility or the lack of it, and partly on the intensity of cultivation, being nearly always high near cities. In South Carolina, however, the upper pine belt leads in this respect, though it has neither the poorest soil nor the largest urban population; and the explanation may be simply that the farmers there (and also in the corresponding part of North Carolina) have acquired the fertilizer habit. A farmer in Marlboro County established a world's record for corn in 1889 by raising 255 bushels on one acre, of course with the aid of heavy applications of fertilizers. It will be noticed that the expenditure for fertilizer per acre in the state more than trebled between 1900 and 1910. This may be partly due to a progressive exhaustion of the natural fertility of the soil, and the decline in value of money (amounting to about 40% in that decade) following the discovery of gold in the Klondike region in 1897, certainly had something to do with the increased expenditure, but after making allowance for these a growth of the practice of using commercial fertilizers is still apparent.

The percentage of whites among the farmers does not differ much from that among the total population, except that it is decidedly larger in the poorest region and smaller in the coast strip; in the latter case perhaps because of the scarcity of good water in the rural districts, a condition which negroes can endure better than whites.

White farmers have the smallest farms and poorest buildings in the Cape Fear region, where white illiteracy is most prevalent, and the other extreme in all three particulars is the coast strip, long characterized by large plantations of rice, sea-island cotton, and other crops not grown much in the interior. There the average white farmer cultivates over eight times as much land as the negro, and has a home worth nearly nine times as much. As already noted under the head of illiteracy, the negroes vary less in different regions than the whites. They seem to prosper most in the Piedmont region and least in the two regions along the coast; but that does not necessarily indicate that the coast negroes are not the most contented.

Looking at the last two lines of the table it will be noticed that the cultivated acreage and building values of white farmers increase with the proportion of negroes, just as the illiteracy for the same race decreases, which is contrary to the opinion held in some quarters that the presence of an inferior race in large numbers tends to lower the civilization standards of the superior race.

In the state as a whole the farms of white men decreased in size between 1900 and 1910 (following a pretty general tendency throughout the country, correlated with increasing population and increasing agricultural efficiency), while those of negroes increased a little. The average white farmer's buildings doubled in money value during the same period, while the negro's increased nearly 2½ times. Part of this increase of value is only apparent, as explained under the head of fertilizers a few paragraphs back, but after making allowance for that substantial improvement is evident. Just how long this had been in progress is not certainly known, for the census made no returns of farm-building values prior to 1900, nor did it separate the races of farmers until then.

The relations between soil, population, race, education, improved land, farm areas, building values, etc., pointed out here, are not peculiar to South Carolina by any means, but have been found to apply in much the same way in Georgia, Alabama, and other southeastern states, a fact which should be of considerable interest to geographers.

FLORIDA GEOLOGICAL SURVEY.

NOTES ON THE LOWER BASIDIOMYCETES OF NORTH CAROLINA *

By W. C. Coker

Plates 23 and 30-66

With the exception of some minute forms parasitic on insects, etc., the true fungi may be divided into three great classes, as follows:

A. Phycomycetes. Simple plants of webby or moldy growth, not forming large or complicated fruit bodies. In their reproduction they are distinguished by the presence, in most cases, of true eggs or gametes in addition to asexual spores. They include, among other forms, some of the molds, such as the black mold on bread, the downy mildews, which are destructive parasites on higher plants, as grapes, potatoes, etc., and the water molds, one of which causes a disease of fish. None of this group will be treated in this work. A separate book on the water molds of the United States will be published soon.

B. Basidiomycetes. To this group belong the vast majority of mushrooms and toadstools. With the exception of some of the lower groups, such as the rusts and smuts, which are diseases of higher plants and are not treated in this book, they form in nearly all cases a complicated fruit body that we usually speak of as the plant, but this body is the product of an extensive vegetative system of a webby or cottony character which ramifies through the earth or wood from which the mushroom arises. The most distinctive character is the production of the spores on the ends of club-shaped or pear-shaped microscopic branches or basidia which are formed on certain parts of the fruit body, and help to make up a distinct spore-producing surface or layer called the hymenium. In most species each basidium produces four spores on its end, each supported on a slender stalk.

C. Ascomycetes. A very extensive group of fungi of great economic importance because of the large number of destructive parasites it contains. They are quite varied in form and size, ranging from minute (as in many parasites, in yeast, etc.) to moderately large (as in the Morels). The spores are contained in sacs which

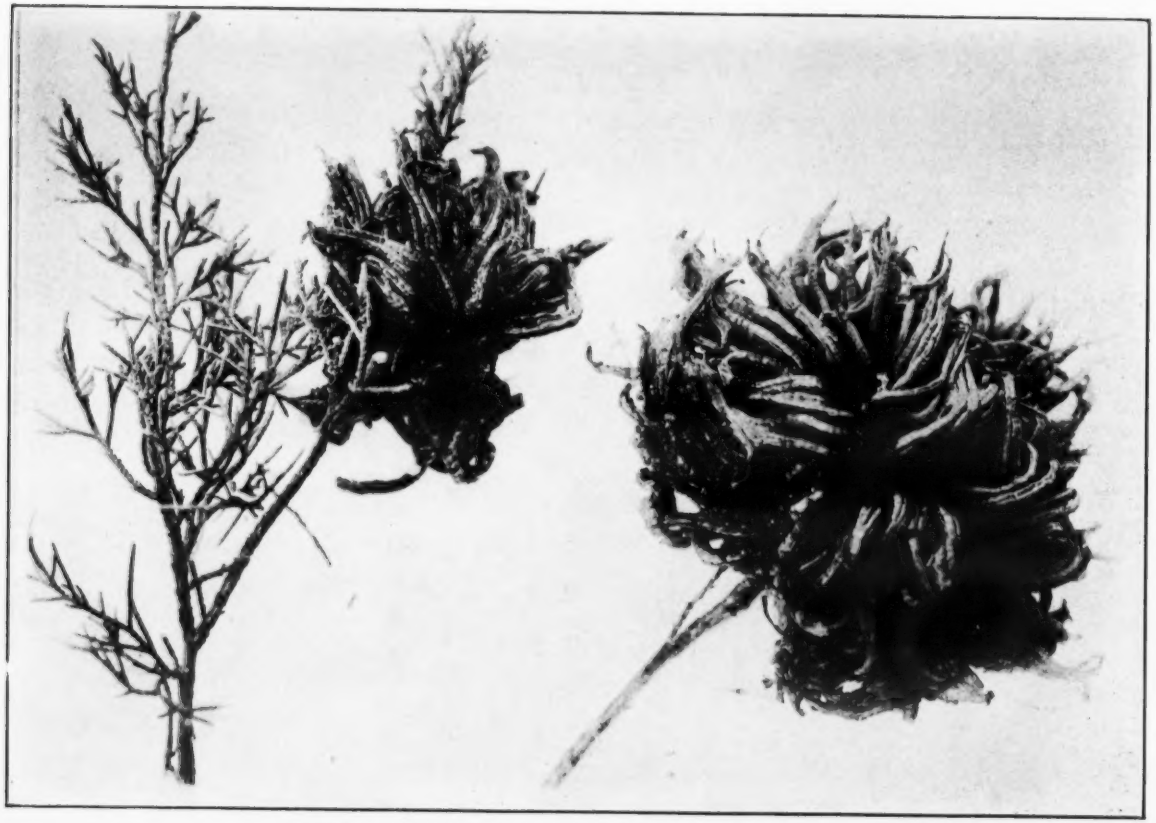
* Many of the drawings in this chapter were made by Miss Alma Holland, Assistant in Botany. Mr. J. N. Couch, Assistant in Botany, drew most of the figures of Gymnosporangium, Septobasidium and Sebacina. A good many figures were drawn by the author and inked in by Miss Holland. The colored plate was painted in part by Miss M. E. Eaton, of New York, and in part by Miss Cornelia S. Love, of Chapel Hill.

are usually elongated and which discharge by the rupture of the tip. There are usually eight spores in each sac, but this number is in some cases increased by the division of the original ones into several or many before they are discharged. Only a few of the larger forms will be treated in this series of papers, and the key to their families will be given later.

KEY TO THE FAMILIES OF BASIDIOMYCETES

1. HYMENOMYCETES: Hymenium (spore bearing surface) exposed before maturity and composed of gills, tubes or spines, or in some cases quite smooth. (In those mushrooms which are enclosed in a cup when young the cup is broken and the plant emerges before the spores are ripe.)
   - Basidia elongated and divided into four or fewer cells by cross walls; texture of plant toughly or softly gelatinous or waxy in the species here treated (of the very large group of rusts we are treating only a few species of Gymnosporangium, which are gelatinous at one stage).
     - Basidia arising from a specialized, thick-walled, constricted spore, which is two-celled in the species here treated (the other families of rusts are here omitted)..*Aecidiaceae* (p. 115)
     - Basidia not arising as above, but from hyphal threads, or in Saccoblastia from thin-walled, lateral, pendat sacs .....*Auriculariaceae* (p. 119)
   - Basidia divided across into several irregular cells; texture of plant fibrous and leathery ....*Septobasidium* (in *Auriculariaceae*) (p. 125)
   - Basidia ovate, pyriform or spherical, divided into two or four cells by longitudinal or oblique walls
     - Basidia arranged in rows of several; texture gelatinous .....*Sirobasidium* (p. 128)
     - Basidia single; texture in one group gelatinuous and forming erumpent, folded or convoluted masses; in another forming thin, resupinate, tough, leathery and coriaceous crusts; in one gelatinous genus with the form and teeth of a Hydnum....*Tremellaceae* (p. 129)
   - Basidia long, slender, terete, forked above into two long branches, not divided into cells; texture gelatinous or sub-cartilaginous.....*Dacrymycetaceae* (p. 160)
   - Basidia not divided into cells and not forked, mostly club-shaped
     - Hymenium smooth; form of plant various, but without sharp distinction between an expanded cap and a stem, sometimes completely spread out (resupinate) on the substratum.
       - Texture tough, leathery and fibrous; if branched, the branches not rounded (except in a few species)....*Thelephoraceae*
       - Texture softer, fleshy; plant cylindrical or club-shaped and un-

PLATE 30



GYMNOSPORANGIUM JUNIPERI-VIRGINIANAE. No. 2307a.

branched or more often branched like a coral or bush or tree.....*Clavariaceae*

Texture fleshy; plant mushroom-shaped or trumpet-shaped; hymenium borne on the under side and often slightly wrinkled.....*Craterellus**

Hymenium borne on pendant teeth (if gelatinous see Tremellodon) .....*Hydnaceae*

Hymenium borne in pores, or if gill-like (Lentinus) then the plant is very tough, dry and corky.....*Polyporaceae*

Hymenium borne on gills; plant more or less soft and fleshy.....*Agaricaceae*

2. GASTEROMYCETES: Hymenium enclosed until maturity inside the plant body and not breaking out at all (as in the puff balls) or exposed at maturity by being elevated on a stalk (as in the phalloids); in one family forming a nest-like cup containing "eggs" at maturity.

Plant body more or less spherical or pear-shaped, sometimes stalked, opening at one or more places or wearing away to expose the spore mass .....*Lycoperdaceae*

Plant body breaking from an egg-like case at maturity and forming a delicate, more or less porous stem, which bears at its tip a smooth or folded or complicated or divided structure which supports the slimy and bad-smelling hymenium .....*Phallaceae*

Plant body small, forming a sessile or stalked cup which opens at maturity to expose a group of egg-like bodies within .....*Nidulariaceae*

AECIDIACEAE

In the most recent monograph of the true rusts or Uredinales by Arthur (N. Am. Flora 7:83. 1907) the order is divided into three families, the Coleosporiaceae, the Uredinaceae and the Aecidiaceae. Of these the last family is by far the most important economically and contains some of the most serious diseases of fruits and farm crops. The number of species is so large and the life history so complicated by a number of spore forms and an alternation of two generations, often on different hosts, that a study of the rusts is now almost a subject in itself. This complexity, together with their economic importance, has resulted in the production of a very large literature to which one may be guided by any of the recent text books on Plant Diseases, such as Duggar's *Fungus Diseases of Plants* and Stevens' *Fungi which Cause Plant Diseases.*

The destructive rusts of grains, grasses and clovers cause a loss of millions of dollars in the United States yearly. To them are closely

* Treated in the Agaricaceae. See this Journal **35**: 31. 1919.

related the rusts of apples, quinces, haws, etc., that cause much damage in the South Atlantic states and which infest the red cedar as their alternative host. We have chosen three species of these cedar rusts to represent the group of rusts in this paper. They belong to the genus Gymnosporangium in the family Aecidiaceae.

GYMNOSPORANGIUM

Producing on cedar in wet weather in the spring conspicuous masses of yellowish jelly either directly on the twigs, branches, or main trunks or on special large galls on the small twigs. This jelly contains a large number of two-celled spores, called teleutospores or teliospores, which sprout at once in the jelly to form elongated basidia, called promycelia, which are divided into four cells by cross walls, each cell sprouting to form a smaller curved spore called a sporidium. These last are then blown about and falling on leaves or fruits of apples or their relatives may infect them and produce in a few months discolored yellowish spots which produce on the underside tubular projections in which are borne in chains another kind of spore called the aecidiospore or aeciospore composed of one cell with a warted wall. These when blown back to the young cedar will infect the leaves and cause the development of the large galls again which are full grown and produce spores the second spring after the infection. The life history of these rusts thus requires two distinct hosts and each must be infected by spores borne on the other. On the upper side of the infected spots on the apple, etc., are borne in sunken flasks very small pycniospores which have no known function. Of the many species of the genus we select three that are found in Chapel Hill.

In addition to the treatment in North American Flora and in the texts mentioned, where references are given, one may refer to detailed work by Heald on the life history of the apple-cedar rust in the 22d Rep., Nebraska Agr. Exp. Station, p. 105, 1909; also a paper by Coons in the same series 25th Rep., p. 217, 1912.

KEY TO THE THREE SPECIES TREATED

All forming gelatinous excrescences on cedar (*J. virginiana*) in spring.

Forming globular, uneven balls which vary in size from a pea to a small apple, from which long gelatinous processes arise..... .....*G. Juniperi-virginianae* (1)

Forming rough and usually thickened areas on twigs

PLATE 31

GYMNOSPORANGIUM NIDUS-AVIS No. 2772*a* (right). Much reduced.
GYMNOSPORANGIUM GERMINALE (left). Reduced.

and branches, or less often on trunks, from scars on which arise globular or wedge-shaped, often confluent and irregularly-diffused masses of jelly

Jelly masses, only up to 7 mm. high, small and rounded; teliospores, 17-23μ thick.....*G. germinale* (2)

Jelly masses wedge-shaped, up to 25 mm. high; teliospores, 13-18.5μ thick.....*G. Nidus-avis* (3)

1. **Gymnosporangium Juniperi-virginianae** Schw.

G. macropus Link

PLATES 30 AND 52

This species is easily recognized on cedar by the large brown balls with shallow pits which form long, tentacle-like, gelatinous processes in wet weather in spring. After forming a crop of spores the balls die and turn blackish. The mycelium is not perennial but grows on the cedar through about twenty-one months from the infection of a leaf in July and August to spore formation a year from the following April. Infected apple leaves show thickened spots that are yellow or orange and on these spots below are several clusters of pale tubes which soon become lacerated and torn and more open. From these drop the brownish aeciospores which again infect the cedars. The elongated teliospores are 11-17 x 34-70μ and sprout from near the septum.

The abundance of the cedar in this section makes the infection of apples very easy and, with the exception of San Jose scale, which is much more easily controlled by spraying, this is the most serious apple disease in Chapel Hill. There is hardly a cedar tree in town without these rust balls on them and apple trees near them frequently lose nearly all their leaves in June and July and grow a new set by August. Different kinds of apples show great variation in resistance to the disease, the most immune apparently being the Staymans Winesap. Shockley and Bonum are very susceptible.

2307*a*. On *Juniperus virginiana*, May 7, 1915.

2. **Gymnosporangium germinale** (Schw.) Kern

G. clavipes Cooke and Pk.

PLATES 31 AND 52

Attacking cedar twigs about 3-8 mm. in thickness, producing a gradual fusiform enlargement about 5-12 mm. thick. The gelatinous

processes are in the form of low, small, rounded cushions crowded all around the infected area and are in large part fused into a continuous mass. Teliospores thicker than in our other species, 17-23 x 40-55μ, the upper cell with a single apical pore, the lower with a pore by the pedicel through which the germ-tube may emerge or it may emerge through the pedicel scar itself. The pedicel is stout, slightly swollen a little below the spore, 7-11μ thick at point of attachment.

The aecial stage is on the shad-bush (Amelanchier), affecting the fruits as much or more than the leaves. The infected fruits reach nearly full size and turn reddish where not attacked, but are distorted and imperfect. A tree in the garden at Glen Burnie is infected every year.

2786*a*. On twigs and small branches of cedar, April 9, 1918. Photo.

3. **Gymnosporangium Nidus-avis** Thaxter.

PLATES 31 AND 52

This is not uncommon in Chapel Hill, making rough and unsightly areas and scars on the branches and rarely even on the trunks of cedar. The gelatinous outgrowths are crowded in longitudinal rows often all around the branches for a distance at times of several feet. The branch is not much swollen, but the rough surface due to the ruptured bark makes such places larger. The individual scars are usually oval and about 2-4 x 4-7 mm., approximated by the scars of the preceding years. Gelatinous processes (telia) wedge-shaped, chestnut brown, 7-15 mm. high.

Teliospores (of No. 2772a) two-celled, 13-18.5 x 37-58μ, the two cells often partly separated before sprouting, the upper sprouting apically or at the septum or from both places, the lower from near the septum in one or two places, the slender pedicels not swollen.

This plant does not agree well with *Gymnosporangium Nidus-avis* as described in North Am. Flora (l.c. p. 196), which is said to have larger teliospores with stouter pedicels, the upper cell sprouting apically, the lower at the septum (called "apically" also). But Dr. Kern writes me that he would call our plant *G. Nidus-avis*. He says: "As regards the pores in the teliospores of Gymnosporangium the arrangement is quite variable. The generic description in the North American Flora states that they are usually 2 in each cell, but sometimes 1, 3, or 4, variously arranged, often near the septa, sometimes

apical in the upper, rarely near the pedicel in the lower. After further observations I believe that I have tried to be too definite regarding pore arrangement in the case of some of the species. In *G. Nidus-avis* it certainly is true that often only 1 pore is observed in each cell, apical in the upper, and near the septum in the lower (which is referred to as apical being as near the apex as possible) but frequently there are two pores in each cell, one apical and one near the septum in the upper, and both near the septum in the lower. The telia are often wedge-shaped instead of pulvinate. *G. Nidus-avis* is an unusually variable species and the description in the North American Flora does not provide for the variations as it should."

Our peculiar form of the species was collected by Arthur at Asheville, N. C., and cultures made on apple from his collection produced the typical aecia and pycnia. Infections made March 22nd gave pycnia by April 6th and aecia by April 27th (Mycologia 2:230. 1910).

186*a*. On branches of *J. virginiana* which were 3-4 mm. thick, March 31, 1914.
2772*a*. On branches of *J. virginiana* which were about 0.6-1-3 cm. thick, March 17, 1918.

AURICULARIACEAE

Basidia (in the more typical members of this family) elongated, divided into four or fewer cells by cross walls, each cell sprouting by a slender or a thickish sterigma to form a single spore; form of fruit body various, its texture varying from toughly or softly gelatinous to waxy. Resembling the rusts closely in the basidia and spores, but differing from them in the absence of a thick-walled, abstricted teliospore from which the basidia sprout, and in not being parasitic, but saprophytic on dead wood.

Nearest this family apparently, but doubtfully belonging to it, is the peculiar genus Septobasidium which is parasitic on scale insects and has a fibrous, leathery texture. The basidia are divided by cross walls but are variable in the form and number of the cells, and the number of the cells that produce spores is not known in all cases. We are including it here. See Brefeld l. c., p. 69.

KEY TO OUR GENERA

Texture gelatinous or waxy.
Toughly gelatinous; form more or less resembling an ear, which projects from the wood by a lateral attachment (*compare Exidia gelatinosa*); basidia not arising from a specialized sac ..... *Auricularia*

Texture waxy, form crustaceous and resupinate on the wood; basidia arising from a pear-shaped, hanging sac ..... *Saccoblastia*
Texture waxy; basidia not arising from a sac ..... *Platygloea*
Texture dry and leathery ..... *Septobasidium*

AURICULARIA

Plants sessile on dead wood by a narrow or broad base, crowded and often shelving, more or less cup-shaped; firmly gelatinous and tremelloid when wet, becoming hard when dry; spore-bearing surface rugosely channelled and pitted to resemble an ear. The basidia are long rods with cross partitions dividing them into cells, and from each cell arises a long sterigma bearing a single spore on its end. Spores white, smooth, sausage-shaped. We have but one species.

Auricularia auricula-judae (L.) Berk.

PLATES 32 AND 53

Plants sessile on dead wood by a narrow or broad base, up to 8 cm. in diameter, crowded and often shelving, more or less ear-shaped or cup-shaped, firmly gelatinous, tremelloid and translucent when damp and fresh, becoming hard when dry, a light yellowish-brown color much like that of rubber gloves. The under surface bearing the spores is more or less rugosely channelled and pitted like the inside of an ear, hence the name Jew's Ear. The dorsal surface is densely velvety tomentose with short, simple, crooked hairs.

Basidia long, slender, with cross partitions dividing them into four cells, each cell producing a long sterigma bearing a single spore on its end. Spores (of No. 3129) white, smooth, sausage-shaped, 4.3-5.4 x 10.8-14μ.

Not rare on fallen branches of deciduous trees. Edible. In China this or a closely related species is an important article of food. For illustration see Gilbert in Trans. Wis. Acad. **16**: Pl. 82, fig. 1, 1910.

1074. On a dead oak branch on ground close to Battle's Branch, May 7, 1912.
1075. On a dead oak twig east of Prof. H. H. Williams', October 18, 1911. These were small plants, not over 1.5 cm. broad.
2494. On fallen hickory by Morgan's Creek, 100 yards above Scott's Hole, May 8, 1917. Photo.
3129. On fallen oak tree southwest of athletic field, April 29, 1918.
3835. On fallen oak branch in woods east of cemetery, December 7, 1919. Spores pure white, smooth, bent, 4.8-6.3 x 11-13.7μ.

AURICULARIA AURICULA-JUDAE. No. 2494.

SACCOBLASTIA

Encrusting as a thin or thickish, uneven layer of a buttery, subgelatinous texture; basidia long, divided into four cells by cross walls and bearing four spores as in the rusts, connected below with a large, pear-shaped sac which furnishes the protoplasm for the basidium. Only a few species have been described, two from southern Brazil (Möller, l. c.) and one from Poland (Bresadola: Ann. Myc. 1:112. 1903). Our species is the first from North America. This genus reminds one strongly of the rusts, particularly the genus Gymnosporangium, where the teleutospore sprouts as soon as formed. If the relationship is as close as it seems the pear-shaped sac would be the homologue of the teleutospore. Note that this sac when long is constricted in the middle.

Saccoblastia ovispora Möller var. **caroliniana** n. var.

PLATES 33 AND 53

Forming an extensive, crumpled, convoluted cushion of irregular thickness (about 5-12 mm.), the surface quite uneven and nodulated by lumps and folds; color a dull, pallid straw to pallid white, with here and there darker stains absorbed from the rotten wood; upper surface rather dull, the lower more shining; texture about that of a soft wax, subgelatinous.

Basidia arising in a very peculiar way from the extension of a thread above a lateral, pear-shaped, hanging sac; the true basidium is very much like that of a rust and is divided into four cells by cross walls, each cell giving off a short sterigma at right angles, into which the contents is poured to form a kidney-shaped spore; between the basidium and the sac is a more slender stalk of varying length which is attached to the basidium at an angle or crimp. All or most of the contents of the sac and the stalk pass into the basidium and finally into the spores. Just below the attachment of the sac the whole apparatus is cut off by a wall from the hypha that bore it and below this wall is often formed one or more lateral branches which extend and soon produce another sac and basidium. Sacs 8.5-16 x 25-45μ, the longer ones often constricted; basidiospores subelliptic, flattened or a little concave on one side, smooth, white 7-7.7 x 15-17μ. These spores sprout soon in water to form smaller secondary spores or sporidia of the same shape which are usually about 4.8 x 12μ and borne on longer sterigmata up to 18μ long or more.

Of the two species described by Möller *S. ovispora* agrees best, but differs in the very thin context and the shorter spores and smaller sacs (basidiospores 7-8 x 13μ, sacs up to 8 x 30μ). The crimp or knee where the basidium joins the stalk is also not mentioned by Möller or shown in his figures.

Our plant also is not white but a pale, dull yellowish. These differences are hardly important enough to require the establishment of a new species and I am calling our plant a variety. Drying takes place quite slowly, resulting in a thin, dark membrane which looks like dried cartilage. When placed in water again it revives perfectly to the original form, even the sacs appearing quite normal under the microscope.

Our finding this South Brazilian genus here is remarkable and wholly unexpected. It was brought in by Mr. J. N. Couch, Instructor in Botany, and adds a genus to our North American flora.

4078. In hollow oak tree near Meeting of the Waters, February 4, 1920. The plant formed an almost continuous layer over several square feet of the hollow. Photo. Type.

PLATYGLOEA

We take the following from the original definition of the genus by Schroeter (Krypt. Fora v. Schlesien (Cohn) 3:384. 1889): Fruit body waxy, flatly spread out or weakly swollen; hymenium waxy, smooth. Basidia crowded, divided by cross walls into mostly four cells. [In our Chapel Hill species into only 2-3 cells.] Spores single, colorless. Saccardo adds: spores, lunate, continuous, "producing no sporidia on sprouting (as it seems)." Nine species (none from North America) have been described, eight on wood, one on dung. All are quite small and easily overlooked. Our plants seems to be new. The genus Tachaphantium of Brefeld (l.c. p. 78) is not distinct from this.

Helicogloea of Patouillard (Bull. Soc. Myc. de France 8:121. 1892) is also not different from Platygloea.* One species *H. Lagerheimi* Pat. has been described. It is effused, hyaline, more or less tuberculose, cinereous, 4-5 cm. broad. Basidia 80-100μ long, 7-8μ thick, attentuated below, obtuse above, 3-4 spored. Spores hyaline

* Patouillard writes me: "The genus Helicogloea is not a good genus! It is a true Platygloea, which differs from the typical form in its texture of clay. At the most, it could be kept as a section of Platygloea."

PLATE 33

SACCOBLASTIA OVISPORA VAR. CAROLINIANA. No. 4078.

guttulate, 7-8 x 15μ, conidia ovoid, 7 x 12μ. On decaying wood in Equatoria. It may be our *P. Lagerstroemiae*, but there are discrepancies. For *P. effusa* see Trans. Brit. Myc. Soc. 6:138. 1918.

KEY TO THE SPECIES

Plants pulvinate, not fusing into crust-like masses, sterile threads (paraphyses) absent in the hymenium.....*P. caroliniana* (1)

Plants nodulose-crustose, sterile threads present in the hymenium .....*P. Lagerstroemiae* (2)

1. **Platygloea caroliniana** n. sp.*

PLATE 54

Gregarious but not crowded, forming pulvinate, flattened patches 0.5-2.5 mm. broad and 0.5-1.5 mm. high, dull smoky flesh-color until old, then more sordid and less pink. Surface dull, granular-looking, convex when fresh, even in small plants, convoluted in larger ones, in age becoming flattened by collapse. Texture firmly waxy throughout.

Spores (of No. 4199) sub-oval, smooth, not white, apparently yellowish or pinkish-yellow on a light spore print on a slide, 4-7 x 5-9μ, not divided. They sprout at or near one end to form smaller, secondary spores (sporidia) of more narrow and irregular shape, mostly pip-shaped, but soon becoming irregular or curved by sprouting. Basidia in dense groups of about 8-10, borne in a close corymb, 5.2-6.5 x 15-20μ, swollen, two-celled or some at least with a third, stalk-like cell, each cell sprouting by a rather long or a short sterigma parallel to the long axis of the basidium as in Auricularia.

Threads of the flesh not crowded, branching at open angles about 2-3.7μ thick, the cross walls usually about 55-100μ apart, but variable, no clamp connections, branching near the surface in a densely corymbose manner and terminating in the clusters of basidia. The plants have exactly the appearance of a small Dacrymyces, but the texture is waxy, not gelatinous. There is no discernible root entering the wood.

This cannot belong to the genus *Jola* of Möller, as that has basidia which do not arise in dense groups and which usually arise from a swollen stalk cell. The spores are very narrow, elongated, and curved (in *J. Hookeriana*, 6 x 28-36μ; in *J. javensis* 3-4 x 15-20μ). Moreover, of three species of Jola described all are parasitic on mosses.

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* Just before going to press a letter comes from Patouillard, who says: "*P. caroliniana* is very different from *Helicogloea Lagerheimi* and is easily a good species."

We have decided to let this go for the present in the genus Platygloea, as it is certainly nearest that or Helicogloea Pat., which is very near or more probably the same, as Möller thinks. Our plant, however, has basidia with only two or three cells, and the absence of sterile cells mixed with the basidia is also a difference. It does not seem to agree with any described species of the genus or with *Helicogloea Lagerheimi*. *Platygloea blastomyces* Möller from South Brazil has basidia entirely too long and slender, spores 6 x 12μ. *Platygloea tiliae* (Bref.) Sacc. breaks through bark of Tilia; basidia four-celled, spores 12 x 35μ. *Platygloea Miedzyrzecensis* Bres. is pulvinate, 2-4 mm. in diameter, but the basidia are 3-5 septate, 4-6 x 75-200μ, the spores 7-9 x 10-13μ. (Ann. Myc. 1:113. 1903).

4044. On corticated and decorticated branches of crepe myrtle (Lagerstroemia), January 28, 1920. Spores 3.7-4.5 x 5-7.5μ.

4199. On corticated and decorticated branches of crepe myrtle, March 5, 1920. Type.

2. **Platygloea Lagerstroemiae** n. sp.

PLATES 41 AND 54

At first forming very small pustules up to 1.5 mm. broad with indefinite margins which are usually crowded and densely gregarious, often fusing later to form elongated, more or less nodulated, irregular patches which may extend for 1-2 cm., not convoluted, the surface dull and granular looking; color at first pallid dull white or straw, soon sordid or smoky brown; texture firmly waxy. Hymenium composed of an immense number of small threads, formed by the corymbose branching of the inner threads, among which are the much thicker and elongated, curved basidia which also arise in corymbose clusters of several.

Basidia 5-5.5μ thick, elongated, irregularly curved and bent, usually two-celled, often with a slender basal cell which collapses soon; sterigmata terminal on each cell, ascending, long or short. The basidium begins to collapse while the spores are being formed and its shape is very soon lost. Basidiospores oval or elliptic, usually curved, very soon becoming irregular and often cycle-shaped by sprouting, 4-7.4 x 7.4-12.3μ, the secondary spores of the same shape, the smaller sizes almost certainly secondary, the smaller secondary spores are 1.6-3.7 x 3-5.5μ.

This is quite distinct from the preceding species, differing in presence of sterile threads in the hymenium, in fused and crust-like form with indefinite margin, in color, in larger spores which are more curved and in larger basidia. The form and habit are more like those of a Sebacina than a Dacrymyces. This seems near Möller's *Platygloea blastomyces* from South Brazil, but differs in the thicker and shorter basidia. *Platygloea effusa* Schroeter is also near, but has basidia with four cells and the color is said to be bluish to yellowish white.

4062. On bark or dead limb of crepe myrtle (Lagerstroemia), February 3, 1920. Photo. Type.

SEPTOBASIDIUM

A curious and anomalous genus forming a resupinate crust on living twigs and branches that are usually and probably always infested with scale insects; supposed to be parasitic on these insects. The plants seem more nearly related to the rusts than the higher basidiomycetes, for the basidium arises from a previously formed, subspherical to pyriform cell, suggesting a one-celled teliospore, and is, when mature, elongated, curved and divided across into cells which give off the long, bent, white spores at right angles on short sterigmata. These structures have been imperfectly or incorrectly understood. Texture coriaceous and resembling a Corticium. Of the seventeen species recorded by Burt two are reported from North Carolina. See Burt in Ann. Mo. Bot. Gard. **3**:319. 1916. Also Lloyd: Myc. Notes **51**:720. 1917; and **61**:887. 1919.

KEY TO THE SPECIES

Surface rugose-wrinkled like some lichens.....*S. retiforme* (2)
Surface even
  Paraphyses bent over and interwoven at the surface .....*S. pseudopedicellatum* (1)
  Paraphyses straight or nearly so.....*S. Schweinitzii* (3)

1. **Septobasidium pseudopedicellatum** Burt.

PLATES 34, 66, AND 67

Plant forming a felt-like, thickish crust usually about 2-5 cm. long and 1-2.5 cm. broad; surface smooth until broken up in age, whitish when young, then passing through pale brown to avellaneous or wood

brown and in age blackish brown; dull, not shining, the uneven margin somewhat fimbriated. Substance internally spongy and open, soon composed of delicate little fibrous pillars supporting the dense upper layer and springing below from a thin, superficial layer on the wood. Basidia-bearing cells (protobasidia) thick, single, terminal, surrounded by slender, bent, interwoven threads. Hyphae loosely packed, considerably branched, rarely septate, no clamp connections.

Basidia appearing in spring from the distal ends of the resting cells, irregularly cylindrical or club-shaped, the tip cell pointed at maturity; sterigmata lateral or, on the top cell, apical.

Spores (of No. 4293, print) white, smooth, long, curved, soon divided into about eight cells, 3.5-4.7 x 15.5-20μ, sprouting in water into small sporidia which are 1-1.8 x 3-6μ, or rarely sprouting without dividing into a single large secondary spore about 3 x 12μ. The length of the basidiospores is quite variable. In No. 4286 they were, from a print, 3.7-5 x 18-30μ.

This species attacks colonies of scale insects (*Chrysomphalus obscurus*)* on living bark and at first is a thin weft of pure white threads running over and among the scales; soon it becomes thicker, the insects become more obscured and are finally hidden completely. About this time there appear numerous free, upright, thread-like fascicles of woven hyphae about 1 mm. high, which gives the plant a peculiar hairy appearance at this stage. We have not followed the life history fully as yet, but it seems probable that these fascicles are to become the supporting columns to the upper layer and that they form this layer by later proliferation and fusion of their tips. The plant is parasitic on the insects only and does not injure the tree.

Burt remarks that in this species the spores are formed in May. In Chapel Hill we find in January and February apparently grown and fully thickened patches of the fungus that are still pure white; at the same time are found more mature brown patches, some of which are breaking up from age. Both the white and brown patches show fully formed resting cells near the surface, but younger, less mature white patches show none of these. In late April we find the basidia appearing and forming spores. If placed in a damp chamber after soaking basidia will appear and form spores in about two days. We have noticed that while the insects themselves were only dead shells under

* Determined by Mr. Harold Morrison of the Bureau of Entomology, Washington, D. C. Dr. Speare of the same Bureau finds associated with our specimen another parasite of scale insects, the fungus *Myriangium duriaei*.

PLATE 31

SEPTOBASIDIUM PSEUDOPEDICELLATUM. No. 3936.

the thick white crusts in January, their eggs were apparently in good condition, being plump and juicy. The species is common in Chapel Hill on willow oak, water oak and hornbeam, and we have found it on privet, apple, alder, white oak, pin oak, *Ilex decidua* and *Cornus amomum*.

3923. On live branches of privet by President's home and by Raleigh road, January 9, 1920.
3924. On a recently dead limb of ironwood (*Carpinus carolinianus*) in Arboretum, January, 9, 1920.
3936. On branches and trunk of *Quercus nigra* by Morgan's Creek, opposite Laurel Hill, January 11, 1920. Photo.
3943. On live limb of willow oak in Arboretum, January 15, 1920.
4015. On alder limbs by branch below Cobb's Terrace, January 24, 1920.
4112. On young, living ironwood near Battle's Branch, February 13, 1920.
4157. On apple bark (living) in Dr. Herty's yard, February 21, 1920.
4286. On live branches of *Q. Phellos*, Rocky Ridge Farm, April 25, 1920.

2. **Septobasidium retiforme** (B. & C.) Pat.

PLATES 65, 66, AND 67

Plants forming resupinate, firmly attached, rather hard and tough, thickish crusts with the surface rugose-veined very much like some foliaceous lichens; margin thinner, irregular and whitish; color deep drab brown and finally darker brown, the margin paler. Substance about 2.3-0.5 mm. thick, brown, the central part less dense and composed of upright fibers somewhat loosely packed, but appearing solid under a hand lens. In old crusts this central part collapses first, leaving the outer and inner layers.

In the S. C. collection, made in December, the basidia were just appearing as undeveloped thickenings. Burt found only one spore in his material, so that the spore characters remained uncertain until we found spores plentiful in our No. 4279. Resting cells when mature oval, sprouting in April to form apical basidia. Spores (of No. 4279, print) long, white, curved, 3.8-.5.5 x 17.3-27.5μ, if kept damp dividing soon into about six to eight cells and sprouting by minute sterigmata into oval sporidia, much as in *S. pseudopedicellatum*. Basidia 7-8 x 52-60μ, arising from the tip of the resting cells, 4-celled remarkable in that they fall from the resting cells as soon as fully formed, at least if formed in water; sprouting after falling off into the four spores from lateral sterigmata. In the distal cell the sterigma may be terminal or nearly so. The plant, like the preceding species, grows on plant lice, which are very obvious in

our material. It does not seem to have been reported from either of the Carolinas before, but has been found in the District of Columbia and as far south as Cuba. It is said to grow on apple, pear and peach, as well as other trees.

4279. On live branches of *Q. Phellos*, Rocky Ridge Farm, April 25, 1920.
4294. On the same tree as No. 4279, May 3, 1920.
Hartsville, S. C., on water oak (*Q. niger*), December 25, 1919. Coker.

3. **Septobasidium Schweinitzii** Burt

This is much like *S. pseudopedicellatum*, but is said to differ in the tips of the paraphyses being upright instead of bent and interwoven horizontally. It was originally described from North Carolina as *Thelephora pedicellata*. We have not found it.

North Carolina. Schweinitz.

SIROBASIDIACEAE

Plant gelatinous, soft, pulvinate, small; basidia arranged in chains, divided either into two cells by an oblique septum or into four cells by two longitudinal septa, each cell producing one spore. There is but one genus.

SIROBASIDIUM

As there is but one genus, it may be defined as having the characters of the family. We have found one species in Chapel Hill, and as the genus has heretofore been known only from South America, this adds a genus to the North American flora so far as reported, but Dr. Farlow has collected a minute species of this genus, practically invisible without a lens, on twigs of Viburnum (?) at Chocorua, N. H.

Sirobasidium Brefeldianum Möller

PLATE 55

Forming minute, little pustules about 0.4-1.3 mm. in diameter and 0.2-0.5 mm. high, gregarious but not crowded, smooth, softly gelatinous, not viscid, but slippery, watery-smoky to dusky white (with a tint of flesh in some).

Spores ovate, smooth, hyaline, varying in size, most about 7.5-8.1 x 13.3-13.7μ, sprouting soon to form small oval sporidia. Basidia 10.5-12.6 x 22-40μ, borne up to 6 (or more ?) in chains, pear-shaped, usually with a narrowed base, divided into two cells by an oblique cross wall, each cell sprouting near the apex to form a single spore.

The minute size and obscure color render the plant almost invisible in passing. The plant seems to agree well with *S. Brefeldianum* of South Brazil (see Möller) and adds a genus to the North American flora. Two other species, *S. albidum* Lag. & Pat. and *S. sanguineum* Lag. & Pat., have the basidia divided into four cells by longitudinal or slightly oblique septa. They are both from Ecquador (see Jour. Bot. **6**:465. 1892).

4104. On decorticated rotting branch of *Albizzia julibrissin*, Episcopal churchyard, February 13, 1920.

TREMELLACEAE

Plants growing on wood, more or less gelatinous and translucent, toughish or soft, shrinking and becoming hard on drying, sometimes shelving and irregularly cup-shaped or ear-like, more often irregularly folded and lobed or brain-like or forming simple cushions; in another group thin, tough and leathery or coriaceous, and encrusting wood as in the Corticiums; in one genus (Tremellodon) with an eccentric cap and teeth like a Hydnum on the under surface. Hymenium covering all the exposed surface of the body (as in Tremella) or only the lower surface (as in Tremellodon). Basidia spherical or ovate or pear-shaped, divided into four cells by longitudinal or oblique walls. Basidiospores smooth, subglobose, pip-shaped, broadly elliptic, or elongated and curved; color various. Not yet reported from America are the genera *Protodontia* and *Protohydnum* (See Trans. Brit. Myc. Soc. **6**:69. 1917).

See Tulasne: *Observations L'organisation des Tremellinees.* Ann. Sci. Nat. 3rd series, **19**:193. 1853. Also Tulasne: *Les Fungi Tremellini et leurs Allies,* l.c. 5th series, **15**:215. 1872. (Also the same in English in Proceedings Linnean Soc. **13**:31. 1873). Brefeld: *Untersuchungen aus dem Gesamtgebiete der Mycologie.* Heft. **7**:80. 1888. Gilbert: *Studies on the Tremellineae of Wisconsin.* Transactions, Wis. Acad. Sci. **16**:1137. Pls. 82, 84. 1910. (This gives references to the literature). Morgan: *Myc. Flora Miami Valley.* Journ. Cin. Soc. Nat. Hist. **11**:91. 1888.

KEY TO THE GENERA

Texture gelatinous; shrinking greatly on drying, and reviving again when moistened.
  Hymenium (spore-bearing surface) without spines.
    Spores white, elongated and a little curved like a sausage
      Plants without a central body of different tex-

ture ..... *Exidia*
Plants containing several small seed-like bodies, which become quite conspicuous on drying (in *N. atrata* Pk. the central body is said to be black) ..... *Naematelia nucleata*
Spores white or yellow to orange (*T. colorata* Pk. is said to have raisin-colored spores), spherical or broadly elliptic or pip-shaped, not curved..... *Tremella*
Plants containing a firm, white, central body or a folded white membrane; surface minutely rough.. *Naematelia*
Hymenium with spines ..... *Tremellodon*
Texture fibrous and leathery or toughly coriaceous or varying to waxy; not shrinking greatly on drying.
Plant growing from the ground, resembling a Thelephora, tough, firm, much branched from a fused base; tips white ..... *Tremellodendron*
Plant growing on wood, tough, leathery, resembling a Corticium or a little Stereum; hymenium pink in our one species..... *Eichleriella*
Plant resupinate on wood or encrusting the bases of plants or objects from the ground; white or buff or gray in our species..... *Sebacina*

EXIDIA

Plants pulvinate, convoluted, gelatinous, in some species with small surface papillae or dots, often compounded in lines or masses; arising from a small central point or elongated plate; all the exposed surface bearing the hymenium or only one surface in the more or less flabelliform *E. gelatinosa*. Basidia pyriform to subspherical; divided lengthwise into four cells, each cell with a long sterigma with a spore at its tip. Spores elongated, curved, white, mostly two-celled before sprouting.

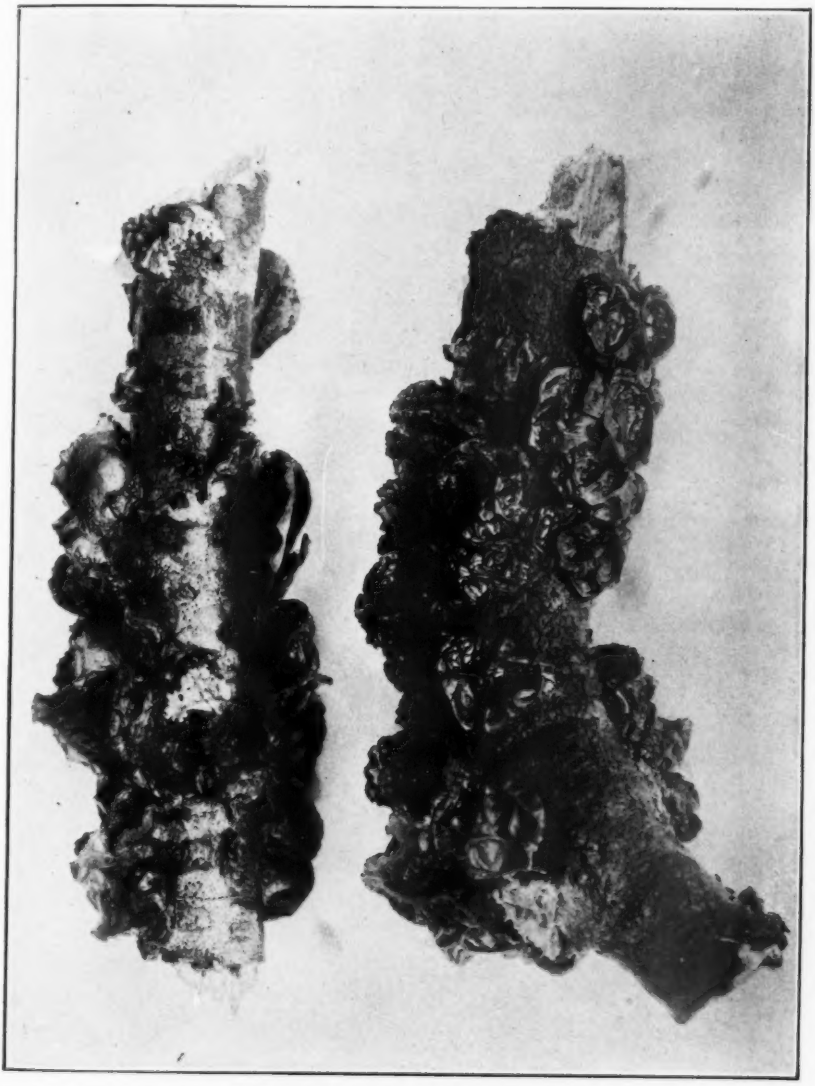
Brefeld has established a genus *Ulocolla* for plants like Exidia that form straight, rod-like sporidia in sprouting, the true Exidias sprouting to form groups of much curved, almost circular sporidia. He retains *E. gelatinosa* and *E. glandulosa* in Exidia, placing in Ulocolla *E. saccharina* Fr. and also *Tremella foliacea* Pers., which he thinks may not be distinct from the preceding. Brefeld erects still another genus, *Craterocolla* for dimorphic tremulose plants with spores like Exidia, and he transfers to that genus *Tremella Cerasi* Schum. (l.c. p. 98).

KEY TO THE SPECIES*

Plant raisin color, set with small darker specks on the sterile side ..... *E. gelatinosa* (1)
Plant dark, blackish-brown, usually with small scattered papillae on exposed surface ..... *E. glandulosa* (2)
Plant raisin color to sordid clay color without specks or papillae ..... *E. Beardsleei* (3)

* For notes on other species see pages 150, 151.

PLATE 35



EXIDIA GELATINOSA. No. 4091.

1. **Exidia gelatinosa** (Bull.) Schroet.
E. recisa (Dittm.) Fr.
Tremella corrugata Schw.
Tremella crenata Schw.

PLATES 35 AND 55

Plant if horizontal from the sides of branches forming flattened, shelving, bracket-like caps; if borne on top or beneath the branch they form crumpled, rather shapeless, more or less flattened masses which are attached by a point or by a more extensive area to the wood; dorsal surface sterile, wet-looking and when seen with a lens showing minute, dark dots; hymenial surface dryer and glaucous from the projecting sterigmata and spores, ridged irregularly like an ear as in Hirneola; there are no papillate projections as in *E. glandulosa.* Texture soft and gelatinous but holding its shape; not so firm as Hirneola, which it rather resembles in form and in the deep blackish wine color; black and shrunken and shapeless when dry. Internal hyphae of fruiting body 2μ in diameter; with cross walls but no clamp connections.

Basidia much as in Tremella, oval and divided into four cells by two longitudinal walls, each cell with a long sterigmata which projects considerably above the surface. Basidia short-oval, 9-10 x 11-11.3μ, situated at and near the surface to a depth of 45μ. Spores white, smooth, sausage-shaped, 3.8-4.5 x 11.2-13.4μ.

Under a microscope the black dots on the dorsal surface are seen to be crusty-looking patches partly embedded and partly free and with much the appearance of small, thickish flakes of bark. These furnish an unfailing means of determination. The absence of the papillae and the flattened form also distinguish this from *E. glandulosa,* while the sausage-shaped spores and smaller size separate it from *Tremella frondosa.*

Very common on fallen oak branches of various species and conspicuous in wet weather. Also on grape, *Prunus*, sweet gum, and elm. Gilbert's figs. 5 and 6 (l.c. Pl. 82) are good of our plant. Brefeld's figure also is good (l.c. Pl. 5, fig. 19). Bulliard's plate 460 (as *Peziza gelatinosa*) gives a poor impression of the habit. For the hymenium and spores see Tulasne l.c. Pl. 12, fig. 2. 1853. From an examination of a collection in the Schweinitz Herbarium I find that *Tremella corrugata* is this species. It has the same characteristic encrusting

particles on the dorsal surface, and there was nothing in the microscopic structure to contradict this. No spores were found. *Tremella crenata* is also the same, the crustaceous particles showing up plainly on wetting in a good specimen from the Schweinitz Herbarium (see page 151). Bresadola has found in the Trentino a plant much like *E. gelatinosa*, but growing on coniferous wood, to which he gives the name *E. umbrinella*. It has not been reported from America, but I find on examination of Peck's type that his *Tremella pinicola* is very like it if not the same (see note on page 150).

116*a*. On dead oak wood by Battle's Branch, December 2, 1913.
3854. Fallen oak limbs, east and southwest of old Graded School, December 9, 1919. Photo.
3900. On fallen branch of white oak, December 13, 1919.
3901. On fallen oak branch, December 13, 1919.
3938. On dead branch of *Prunus serotina* in Arboretum, January 13, 1920.
4089. On grape vine (*V. rotundifolia*), February 4 and 20, 1920. Basidia oval, four-celled, 9.3 x 11μ. Spores smooth, white, curved, 3.7-4.8 x 9.3-13.5μ.
4091. On oak branches back of Athletic Field, January 17, 1920.
4114. On oak limb by Battle's Branch, February 13, 1920. Photo.

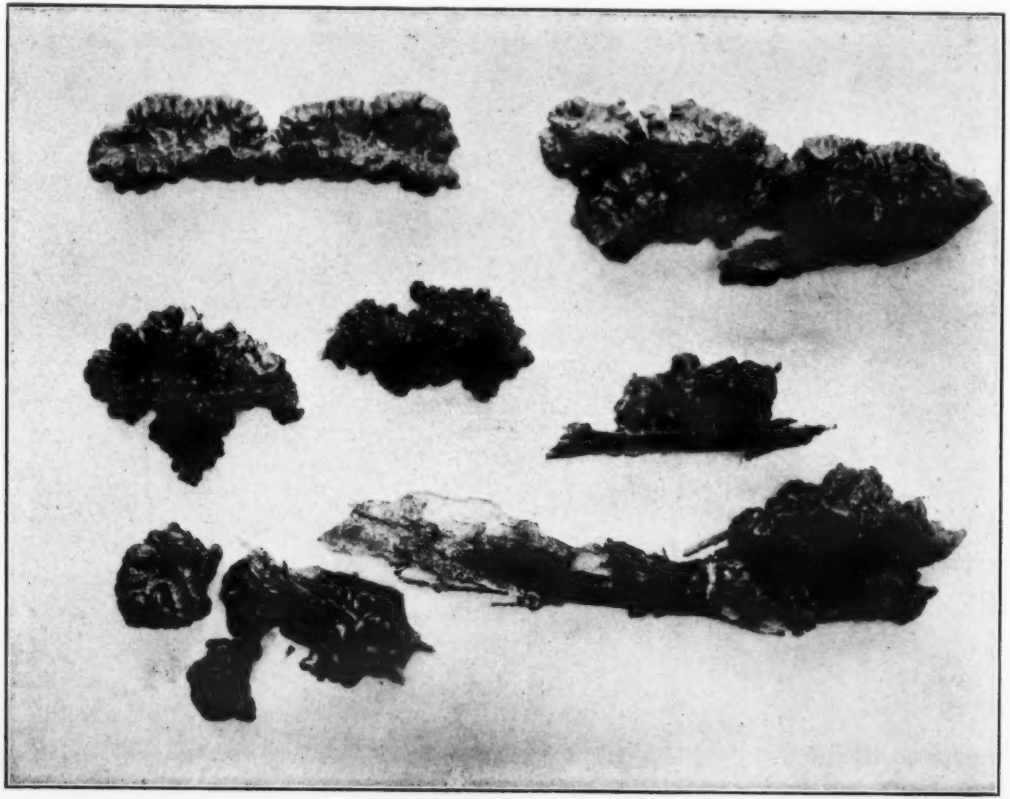
2. **Exidia glandulosa** (Bull.) Fr.

PLATES 36 AND 55

Plant forming convoluted, gelatinous, thickish, pillow-like masses which may be single or fused into long rows along cracks in the bark; narrowly attached and spreading out laterally; upper (outer) surface bearing basidia and faintly glaucous under a lens, also more or less conspicuously dotted in a scattered way with small, black, protruding warts or points; color deep blackish-brown, like very dark wine jelly, the lower surface a little paler, watery-shining and not glaucous or warted; when protected from light, plants are apt to be much paler, approaching white (No. 4198); texture rather firmly gelatinous, deliquescing only when long wet, not viscid. On drying the plants flatten down and collapse into a thin black membrane.

Spores smooth, white, rod-shaped, curved, 3.7-4.1 x 9-12.5μ. In sprouting the contents usually moves to one end, the empty end being cut off by a wall, the protoplasmic end sprouting at the mucro. At times both cells contain protoplasm and both sprout; again no cross wall is formed and the entire spore sprouts at the mucro. Basidia pear-shaped, four-celled by two longitudinal divisions.

PLATE 36



EXIDIA GLANDULOSA. No. 3878.

The smaller, single pustules are about 3 mm. wide and 2 mm. high, the longer, compound ones may reach a height of over a cm. and extend in more or less interrupted rows for a foot or more along the branches. This plant differs from *Exidia gelatinosa* in darker color, smaller size and pulvinate form which is quite unlike the thin, flattened, laterally attached caps of the latter. It also differs in the black papillae on the hymenial surface and the absence of the close-set, dark, inherent dots on the dorsal surface. Very common on many kinds of deciduous trees and shrubs, as on privet, osage orange, Baccharis and others, besides those mentioned below. Individual pustules are often without papillae, and such are probably *E. epapillata* Bref. and *Tremella intumescens* Sm. Brefeld gives the spores of the European *E. glandulosa* as 5 x 14μ which is a little larger than in ours. *Exidia plicata* Klotzsch seems to be another European form on alder with few papillae and slightly longer spores, up to 20μ.

3878. In fallen branch of willow (*Salix nigra*) in Arboretum, December 13, 1919. Photo.

3933. On dead stems of trumpet vine (*Tecoma radicans*), January 9, 1920. Spores as in No. 3878, 3.7-4.5 x 10-13μ.

3951. On *Vitis aestivalis*, January 17, 1920. Basidia 9.3-11 x 11-14μ.

3973. On white birch (*B. alba*) in Arboretum, January 18, 1920.

4188. On oak bark, Strowd's lowgrounds, February 25, 1920.

4198. On oak stick under leaves, March 2, 1920. Basidia oval, 10-11.8 x 14-15μ. Spores 3.7-4.5 x 8-14μ.

3. **Exidia Beardsleei**

PLATE 56

The following is by Mr. C. G. Lloyd:

"Sessile, cushion shape, gyrose, lobed. Color of a raisin. Flesh same color. Papillae none. Basidia globose, 8-10μ, very pale color. Spores hyaline, 5 x 10μ, slightly curved, unilateral, apiculate.

"Were we to determine this from books we should call it *Exidia saccharina*, but we know this in Europe and it is not that species. The color might be compared to brown sugar but better to a raisin. We do not find it in Ridgway, but pecan brown is not far away. While it has no papillae we put it in Exidia on the spores. As previously stated the line between Tremella and Exidia is hard to draw. In general appearance this is rather a Tremella. The color is somewhat like that of *Naematelia nucleata* when old. It dried away leaving hardly a trace on the bark. It grew on frondose wood. From W. C. Coker, North Carolina (No. 4021).

"We published this, Myc. Notes No. 61, p. 898, as *Exidia Uva Passa* (in duplicate) having used this name (54, 774) for a plant from Japan. We are not sure that our American plant is different from the Japanese, but it appears to us to have a more reddish color and smaller spores but it is practically the same."

In accordance with his well-known principles, Mr. Lloyd does not wish the above species name, here first used, to be followed by his name, and I have left it off at his specific request. We have found the plant three times in Chapel Hill, as is indicated by the collection numbers below. Our notes on No. 3930 are as follows (the figures on Plate 56 are ours):

Plant forming small, simple or more complicated pulvinate patches from 1-7 mm. broad and 1-2 mm. thick; surface, unless quite small, with folds like a brain; surface farinose with spores, not papillate, or with a few small, obscure warts, not viscid; color a dull sordid clay; texture firmly gelatinous.

Spores (of No. 3930) white, smooth, rod-elliptic, some a little bent, 4-4.8 x 7.7-11.4μ, a few up to 6.7 x 14.8μ. Basidia (of No. 4191) short-ovate, 9-10 x 11-11.8μ.

When dry the plant collapses down to a thin, scarcely visible, sordid brown membrane which is about the same color as the bark. This cannot be *E. sucina* Möller from Brazil which has similar basidia and spores (basidia 10-12μ, spores 4-5 x 10-12μ) for that is amber yellow in color (a "clear yellow," he says in another place), and is particularly characterized by numerous peculiar enlarged and elongated cells with yellow contents which run from the layer below the basidia up to but not beyond the surface. They are 66-80μ long and 6-8μ thick (Möller l.c. p. 95).

3930. On dead branch of *Robinia pseudacacia* with bark on, January 10, 1920.

4021. On *Robinia* branches on tree, January 24, 1920. Like No. 3930. In drying shrinking down to a nearly black membrane. No white nuclei. Spores white, elliptic, some curved, 3.7-5 x 7.4-11μ. Type.

4191. On decorticated oak wood, February 26, 1920. Color of plant dull reddish amber. Spores smooth, curved, 3.7-4.4 x 8-11.8μ.

NAEMATELIA

Resembling the cushion-shaped Tremellas in form, but differing in the presence of a firm, white or yellowish (said to be black in *N. atrata* Pk.) non-gelatinous central body or membrane which is surrounded by the gelatinous, translucent portion. In drying the gelatinous part shrinks to a membrane and leaves the unshrunken inner whitish part more conspicuous. The genus was established by Fries with *N. encephala* as the typical species (being the first mentioned). He also included *N. nucleata* (*T. nucleata* Schw.), a plant too different in its spores and in the presence of scattered white nuclei to be

cogeneric. It would be just as well probably to place this latter species in the genus Exidia, which differs only in the absence of white nuclei. We retain it here, however, for the present. For article on a supposed Naematelia see Trans. Brit. Myc. Soc. p. 143. 1899-1900.

KEY TO THE SPECIES

Growing on deciduous woods
- Orange yellow; spores subspherical ..... *N. quercina* (1)
- Dull ochraceous or smoky clay to wine color; spores elongated as in Exidia ..... *N. nucleata* (2)

Growing on pine; light flesh-color, then brownish ..... *N. encephala* (3)

1. **Naematelia quercina** n. sp.

PLATES 23 AND 58

Plant forming good sized masses of crumpled and flattened folds which are not hollow and which extend upward about 1.5-2 cm. and laterally about 2-3.5 cm., the surface not smooth but characteristically roughened all over under a lens like a cockscomb; color orange-yellow inside and out except for a thin white membrane about 0.7 mm. from the surface which follows all the convolutions and gives a marbled appearance to cut surface. Texture tough and firmly gelatinous, the surface opaque, only the internal part translucent and paler. The plant enters the bark by a flattened constricted brownish base.

Spores orange-yellow, spherical or short-oval, smooth, 7.4-11μ in diameter. Basidia spherical, divided into four cells by longitudinal walls, 15-20μ in diameter.

This is easily distinguished by the deep color, good size, firm texture, absence of hollows, and by the rough surface and white internal membrane. I have been able to find almost none of this plant in American herbaria, the only two specimens that I am sure of being the same are a plant from Ellis (Newfield, N. J.) in the Farlow Herbarium and one in the Curtis Herbarium from Society Hill, S. C. The former is labelled by Ellis *Naematelia* sp.? It has the same rough surface and white interior. The latter is labelled *T. aurantia* Schw. but is nothing like that species, which is a Dacrymyces. Its basidia are 15-19μ thick, four-parted; the spores 9-10μ thick, subspherical. *Naematelia encephala* Fr. on bark of Abies as represented in the Farlow Herbarium (Vermont, New Hampshire, etc.) has the same peculiar surface and white interior. A plant from Bresadola (New York Botanical Garden) on oak bark called by him *N. encephala* is like our *N. quercina* in surface characters and the basidia are nearly spherical, 14-17μ

thick, but the color is more of a fleshy tan (see also under *N. encephala*). This is probably what he later named *T. encephala* var. *Steidlerii* which agrees well with our plant except that he says the color of the plant is brown and the spores hyaline (Ann. Myc. **6**:42. 1908). Lloyd thinks our plants are *T. mesenterica,* but I am satisfied that it cannot be that species, if indeed that is different from *T. lutescens.* The genus Naematelia may be taken as based on the species *N. encephala* and it seems to me that our plant is sufficiently like it to be placed in the same genus. *Tremella nucleata* Schw., placed in Naematelia by Fries is too different to be cogeneric with the other two, and would probably just as well be put in the genus Exidia.

3935. On oak wood in a wood pile, pushing through cracks in bark, January 18, 1920. Painting. Type.

4111. Deciduous twig by path north of Piney Prospect, February 13, 1920. Surface roughened, the white internal membrane barely showing, not hollow. Plant old and in part turned nearly white, other part watery orange.

2. **Naematelia nucleata** (Schw.) Fr.

PLATES 23, 41 AND 56

Small, pulvinate, nearly even or more often convoluted, flattish or convex or in larger plants pinched up in center; 1-6 mm. in diameter, often crowded into lines which may be up to 1-2 cm. long; gelatinous, translucent; color quite variable, a clear wine color or dull reddish-brown or faded to a pallid watery wine or dusky amber or nearly hyaline; not glaucous; the habit very like that of *Exidia glandulosa.* In the fresh state the whitish, seed-like nuclei may or may not be apparent even though they may show up on drying. Not a few plants of a good sized colony show no nuclei even when dry, and such if found alone would be referred to Exidia. The nuclei are irregularly scattered through the plant and are often so small as to be nearly invisible without a lens. They rarely reach a quarter mm. in diameter.

Spores (of No. 3959) white, curved-elliptic, 3.7-4.2 x 7.4-11μ. Basidia spherical, 10.5-11 x 11-11.5μ.

Schweinitz's description is misleading, but that this is his plant is not open to doubt. A collection from him in the Schweinitz Herbarium looks just like ours with scattered seed-like nuclei. Under the name of *Tremella abida* in the Curtis Herbarium are a variety of plants. One of these from England (Broome) is *N. nucleata.* Another from Massachusetts (Sprague) is a Dacrymyces.

3956. On corticated branch of *Salix nigra*, in Arboretum, January 17, 1920. In this collection the basidia are slightly more elongated than in other numbers, being 8.5-9.3 x 11μ, mostly divided lengthwise into four cells. Spores white, smooth, a little bent, 4-4.5 x 9.3-11μ, apparently one-celled when shed.

3957. On a quite rotten, decorticated branch of English walnut, January 17, 1920. Basidia oval, 9.3μ thick. Spores smooth, bent-elliptic, 3.4-4.2 x 7.4-11μ.

3958. On a decorticated branch of a frondose tree under a grape arbor, January 17, 1920. Plants like No. 3961 in every way except that these are smaller, the pustules being from less than 1 mm. to about 2 mm. broad. Basidia nearly spherical, divided into four cells. Spores curved-elliptic, white, 3.7-4.4 x 8-11.4μ.

3959. On vine of summer grape (*Vitis aestivalis*), January 17, 1920.

3960. On dead vine of scuppernong grape on an arbor, January 17, 1920.

3961. On a small branch of a deciduous tree on ground under grape arbor, January 17, 1920. Painting. Spores allantoid, pure white (print), 3.5-4 x 7.7-14.8μ. Basidia nearly spherical, 9 x 10μ. In the fresh state a few of the plants show small white nuclei.

4023. On bark of standing dead *Salix nigra* in Arboretum, January 24, 1920. Habit of *Exidia glandulosa*, not papillate, faintly glaucous, at times crowded in rows up to 3.5 cm. long from a common, plate-like root. Spores 4-4.4 x 9-12μ. Basidia oval, 8.5-9.5μ thick, divided lengthwise into four cells. Painting.

4046. On *Ampelopsis tricuspidata*, January 28, 1920. A great variety of color shown in this lot, some watery white, others pale lavender or amber or reddish wine, etc., the whitish nuclei showing up at least when dried as little subspherical eggs that vary in number and size.

4154. On deciduous wood, February 21, 1920. Spores smooth, white, bent, 3.8-4.2 x 7.5-11.4μ.

4169. On an oak branch with bark, February 25, 1920.

4189. On oak in Strowd's lowgrounds, February 25, 1920. A fine collection with white nuclei very conspicuous.

North Carolina. Schweinitz.
Common on fallen limbs. Curtis.

3. **Naematelia encephaliformis** (Willd.).

The following is Fries' description from Epicrisis, p. 591 (as *N. encephala*):

"Subsessile, pulvinate, plicate-rugose, pallid flesh-color, at length brownish. Nucleus large, firm, white. . . . . Frequent on pine branches in winter."

The spores are given by Brefeld as like those of *T. globulus,* which are 15-18μ thick, oval; basidia large, oval (l.c. p. 128). But Bresadola after his description of var. *Steidlerii* on oak says that the spores of the typical form on pine are globose 8 x 8-9μ and not as Brefeld gives them (Ann. Myc. **6**:46. 1908).

A collection of this species from Fries on pine bark in the Curtis Herbarium is, in the dry state, about 3 mm. broad and 2 mm. high and the color of resin. Collections in the Farlow Herbarium from Vermont and New Hampshire on bark of Abies have a rough surface almost exactly like that of our *N. quercina.* This is also true of a collection in Schweinitz Herbarium on pine from Bethlehem. It is surprising to find that Bresadola has referred to this species a plant on oak bark. A specimen from him so labelled at the New York Botanical Garden is somewhat like my *N. quercina* but of a fleshy tan color. (See under *N. quercina*). Both Person and Fries use the specific name *encephala,* why, I do not know as Wildenow published it originally as *T. encephaliformis.*

Middle and upper districts, on fallen limbs. Curtis.
North Carolina (Salem?). Schweinitz.

TREMELLA

Plants firmly gelatinous, folded, lobed or wrinkled, or in one case with thick upright branches; color white, yellow, orange, brownish, whitish or pinkish or purplish or raisin color; becoming tough and horny when dry and, in most species, shrinking greatly; basidia spherical to pyriform, longitudinally or obliquely divided into four equal or unequal cells, from each of which extends a long sterigma with a subglobose or pip-shaped, or broadly elliptic, white, yellowish, purplish or umbrinous spore on the end. The spores often sprout if put in water as soon as shed, forming a rather short promycelium or sterigma with a single round or broadly elliptic spore on the end, or they may form numerous small sporidia as buds from the surface. The species with spherical or plumply elliptic spores form a natural group and are typical Tremellas. *Tremella reticulata* with upright, hollow branches and pip-shaped spores should be placed in a separate genus. None is known to be harmful. For development of basidia see Wager in The Naturalist **695**:364. 1914.

The plant growing parasitically on *Collybia driophila* and named by Peck *Tremella mycetophila,* was referred by Burt to Exobasidium

PLATE 37

TREMELLA RETICULATA. No. 2690.

(Bull. Torr. Bot. Club, 28:287. 1901), but he now considers it an abnormal excrescence of the mushroom itself (Ann. Mo. Bot. Gard. 2:656. 1915). We have found it here.

KEY TO THE SPECIES INCLUDED

Plants growing upright from the ground, with stout, hollow branches ..... *T. reticulata* (1)
Plants with thin, complicated, flattened, crowded, or open lobes; spores subspherical or jug-shaped, white.
  Color nearly pure translucent white ..... *T. fuciformis* (2)
  Color a translucent fleshy brown or raisin-clay or a deeper raisin color
    Spores subspherical, plant large
      Surface quite smooth; spores less than 8μ thick ..... *T. frondosa* (3)
      Surface roughish; spores more than 8μ thick.. *T. aspera* (4)
    Spores jug-shaped, plant small ..... *T. auricularia* (5)
Plants forming dense yellow or orange masses composed of folded and more or less flattened lobes; spores yellowish or orange.
  Growing on decidious wood..... *T. lutescens* (6)
  Growing on pine ..... *T. pinicola* (7)
Plants forming pulpy, diffused, amber-colored masses on dogwood or oak branches; spores pale, broadly elliptic ..... *T. virens* (8)
Plants forming small, irregular, convex, whitish or pinkish or creamy and usually much crowded cushions with brain-like folds; spores white..... *T. carneoalba* (9)
Plants in form like the above, but color pallid brown to wine-brown and when dry nearly black..... *T. subanomala* (10)
Plants in form something like the above, but purplish, almost black ..... *E. moriformis* (11)

1. **Tremella reticulata** (Berk.) Farlow.

? *Tremella vesicaria* Bull.
Sebacina tremellosa E. & E.

PLATES 37 AND 56

Plants 4.5-8.5 cm. high, 4-5.5 cm. broad in our collection, reaching at times a greater width, arising in a contorted and complicated way from the ground, and composed of more or less fused and anastomosing branches which end in blunt tips as in a coarse and dropsical Clavaria; color dull creamy white, not viscid, all parts hollow; semi-translucent, tough and elastic like a very firm jelly, not tremulose, almost tasteless and odorless.

Spores white, elliptic to pip-shaped, with a large mucro at one end, granular, smooth, 4.4-7 x 8-12.5μ. Basidia oval, 8.5-10.5 x 11-12.9μ.

This is the *T. fuciformis* of Atkinson's American Fungi, fig. 196, but I am following Farlow who seems to be right in determining it as *T. reticulata* (see Rhodora **10**:9. 1908). Lloyd thinks our plants are the same that pass in Europe as *T. vesicaria* (see Bulliard's Pl. 427), but that it is not the true species of Bulliard. See also a good photo by Lloyd in Myc. Notes, Old Sp. Series No. 1, fig. 224. 1908 (as *T. clavarioides*). His fig. 1562 in Myc. Notes **61**. 1919, as *T. sparassoidea*, is probably the same also. (See also Myc. Notes **62**: fig. 1646. 1920, and Mycologia **12**: 141, Pl. 10, fig. 3, 1920).

2690. Low damp woods by creek, upper Laurel Hill, July 17, 1917. Photo.

2. **Tremella fuciformis** Berk.

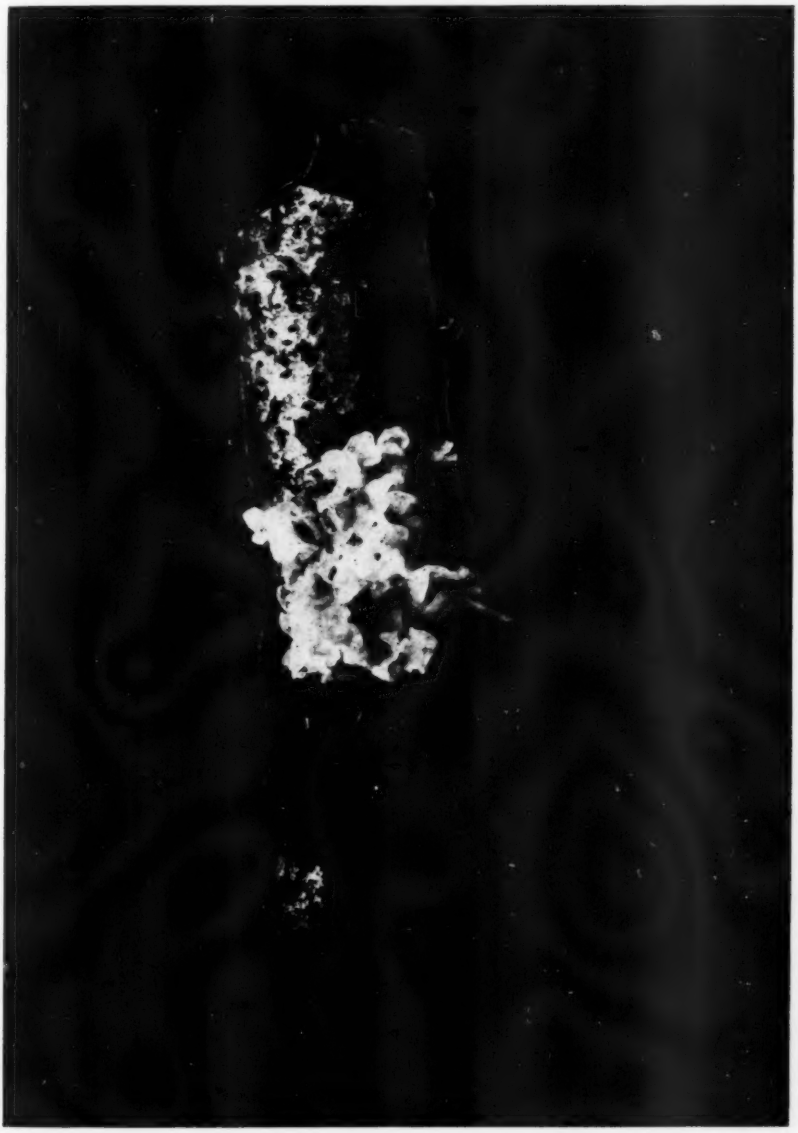
PLATES 38 AND 56

Plant forming a mass about 5 cm. long and 2 cm. high, composed of thin, flat, much crinkled and fluted lobes, texture tremulose, but quite tough; color a slightly soiled, translucent white.

Spores white, subglobose, smooth with a large oil drop, about 6.2μ in diameter. Basidia divided longitudinally into four cells, short and thick with long sterigmata.

According to Lloyd this is the true *T. fuciformis*, and is, he says, the third specimen known from the United States (but see notes under *T. lutescens*). The species was described from the Amazon and later recorded from Cuba and Jamaica and only reaches our southern states, the Orange County collections being the most northern record (see Farlow in Rhodora **10**:10. 1908). In a letter to me of September 3, 1918, Lloyd says that it has probably passed with southern "collectors as '*Tremella albida*,' our common, white northern species. But *Tremella albida* of America is an entirely different plant from *Tremella albida* of England." (See also Myc. Notes No. **55**:790, fig. 1188. 1918. Also *ibid.*, No. **40**:556. 1916). *Tremella albida* of Europe is now known by most authors as *Exidia albida* (Huds.) Bref. and differs sharply from our No. 1408 in the elongated, curved spores (4-6 x 12-14μ Karsten). The figure given by Möller of *T. fuciformis* (from Brazil) in his Protobasidiomyceten, Pl. 1, fig. 5 (1895), is like our plant in all essentials. See also the good photo by Lloyd mentioned above. The spores agree with Möller's measurements. For illustrations see Gilbert in Trans. Wis. Acad. **16**: Pl. 83, figs. 17-22. 1910. *Dacrymyces pellucidus* Schw. is probably the same thing. See page 173.

PLATE 38



TREMELLA FUCIFORMIS. No. 1408.

1408. On a fallen oak branch, Tenny's ravine, October 20, 1914. Photo.
3979. On decaying oak log, Strowd's lowgrounds, January 18, 1920.

3. **Tremella frondosa** Fr.

PLATES 39 AND 56

This is much the largest of our Tremellas, forming a mass up to 15 cm. in diameter, and up to 7-10 cm. high of flat, very thin, crumpled and contorted, petal-like lobes of a gelatinous but quite tough consistency like rubber; fused below into flattened and more or less extensive base which enters the wood. Surface quite smooth and, unless old, glaucous with the spores; color when fresh and not too old a rather light fleshy brown, in age becoming darker; drying to a raisin color if fresh, or to blackish if old. In drying there is much less shrinkage than in other species and the form is well retained.

Spores (of No. 4173) white, smooth, spherical to short oval. 5.5-7.7 x 6-10.5μ, a few 8.5μ wide. Basidia pear shaped, irregularly divided into four cells, 7.7-9.3 x 11-15μ, some up to 18μ.

Edible. Our nearest relative of this is *T. aspera* which may approximate it in size and color. For easily distinctive marks see under that species. Bulliard's Pl. 499, fig. 6T is good of the plant, so also is Lloyd's fig. 1195 in Myc. Notes **55**. 1918. Brefeld gives the spores of this species as spherical with a mucro, 10-12μ (l.c. p. 122). Under the name *T. foliacea* in the Curtis Herbarium are most of the large leafy Tremellas, some of which are certainly *T. frondosa*. The difference between these two species, if any, does not seem to be well established. See Gilbert's illustrations in Trans. Wis. Acad. **16**: Pl. 82, figs. 13, 14. 1910.

536. On a small oak log east of school house, October 9, 1912.
1006. On oak stump in Dr. Pratt's yard, October 4, 1908.
1372. Battle's Park, southeast of Dr. Battle's, October 17, 1914.
2456. On an oak log, swamp of Bowlin's creek, October 1, 1916.
4173. On oak wood, February 23, 1920.

4. **Tremella aspera** n. sp.

PLATES 40 AND 56

A good-sized plant, in our one collection about 3-5 cm. long, 2-3 cm. broad and 3-4 cm. thick, formed of flattened, much crumpled and contorted lobes which arise from more or less extensive and separated points of attachment; surface not smooth, but finely granular under a

lens; color of raisins, but much darker in age; gelatinous and rather tender.

Spores pure white, spherical with a distinctive mucro, 8.6-11.8μ. Basidia subpyriform, large, divided quite irregularly into four cells, 15.5-18.5 x 20.2-25.9μ.

There seems to be no agreement among European botanists as to what *T. foliacea* Pers. is (if indeed different from *T. frondosa*), and furthermore our plant does not agree with any of them. Bresadola's idea of *T. foliacea* is that it grows on Larix and Abies 4-8 cm. high and broad, from hyaline-saccharine to fleshy-isabelline tinted with umber-violet. Spores hyaline, globose, 7-10 x 7-9μ, basidia subglobose to ovate, 16-18 x 14-16μ. Subhymenial hyphae 2-2.5μ thick (Fung. Trident. p. 97, Pl. 209, fig. 1). This conception is evidently quite different from that of Brefeld (l.c. p. 98) who places *T. foliacea* in the genus *Ulocolla* and doubts its distinction from *U. saccharina* (previously *Exidia saccharina*) which, he says, has identical basidia, spores and sporidia, as well as color, and grows also on coniferae.

This species differs from *T. frondosa* in rougher surface that is not glaucous, larger spores and much larger basidia, more complicated, crumpling, thicker, less simple and less perfect lobes, more tender structure, and darker color. In drying *T. frondosa* shrinks very much less than *T. aspera* and does not become so black.

3950. On decaying oak stump back of Power Plant, January 17, 1920. Photo. Type.

5. **Tremella auricularia** Möller

PLATE 62

Forming a flat, somewhat crumpled, folded, erect and branched plate about 1.5 cm. long and 7 mm. high and less than 1 mm. thick; color a dull reddish clay, almost intermediate between raisin color and clay color; surface smooth. Texture softly gelatinous and tender.

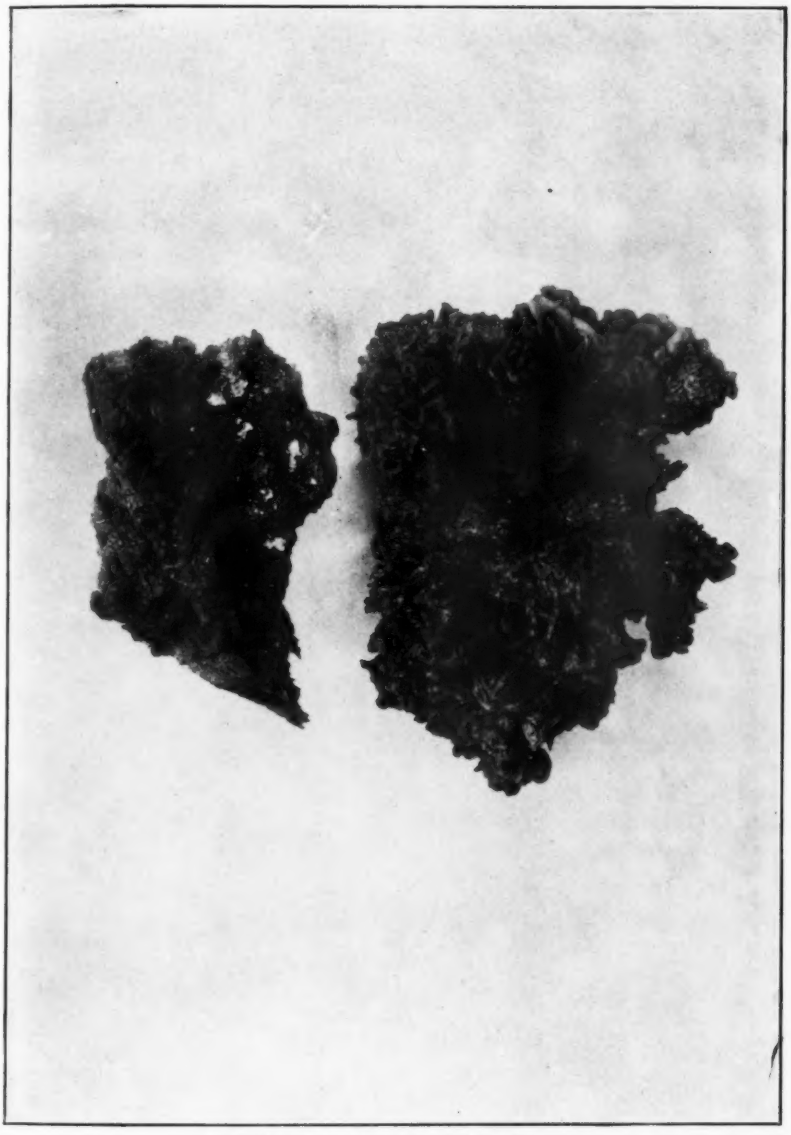
Spores white, elliptic or in one view approaching jug-shaped, 5.2-9.7 x 9.3-15μ, a few oval. In sprouting the spores form a good number of very small spherical sporidia about 3-5μ thick, which absorb all the contents and form a group in place of the collapsed and almost invisible spore. Basidia four-celled, 12.5-15μ thick.

This is easily different from our other species in the white, jug-shaped spores, small size, delicate texture and dull color. That it is Möller's species seems certain. His description and figures agree,

PLATE 39

TREMELLA FRONDOSA. No. 536.

PLATE 40



TREMELLA ASPERA. No. 3950.

the spores having just the right shape and sprouting in the same quite peculiar way. The spores are said to be pear-shaped, 10-12μ thick; basidia 15μ thick (see Möller: Protobasidiomyceten, p. 170, Pl. 4, fig. 16. 1895).

4159. On privet (*L. sinense*), February 21, 1920. Drawings.

6. **Tremella lutescens** Pers.

PLATES 23, 41 AND 57

Plant forming an elevated, lobed mass with a surface of crumpled folds resembling somewhat a duodenum, many of the larger folds hollow, emerging from a small attachment and often bursting through the bark; surface not rough; breadth about 1-2.5 cm., height about 3-17 mm., surface dull, glaucous from the spores, color pale orange to clear orange, drying usually a rather darker orange and retaining much of its form. Texture firmly gelatinous, much less soft than *Exidia gelatinosa*.

Spores (of No. 3895) smooth, spherical to short-elliptic, 6.3-9 x 7-13μ, varying in size with the cells from which they spring. Basidia pear-shaped, divided into cells by longitudinal or slanting or quite irregular walls, the cells often quite unequal in size.

Easily recognized by its bright color, folded and hollow structure, medium size, glabrous surface, absence of a white membrane within and growth on deciduous wood. This seems very like *T. compacta* Möller from Brazil in form, size, color and hollow lobes, but that is said to have basidia 12-14μ thick and spores 6-7μ thick (Möller l.c. p. 107). See also Lloyd in Myc. Notes **58**:825. 1919. In the Curtis Herbarium plants labelled *T. lutescens* are mostly T. *fuciformis*. Such are plants from Hillsboro, N. C., Santee Canal, S. C., and Alabama. One so labelled from the Schweinitz Herbarium (Bethlehem) is a Dacrymyces with large eight-celled spores, 7-7.8 x 20-23μ. It looks like Curtis' Society Hill Dacrymyces which he calls *T. aurantia*, but which is not that species.

This I have decided to call *T. lutescens* rather than *T. mesenterica* although I am far from convinced that these two species are properly understood either in Europe or America, if indeed they are distinct. There are no serious discrepancies between our plant and *T. lutescens* as understood by Brefeld. His plant, contrary to the usual statement, is orange when young, paler in age. The plant is usually re-

ferred to as paler than *T. mesenterica*, whitish in youth. Brefeld states the spores as being round with a point, colorless, 12-15μ thick. He received one plant from a correspondent that he took to be *T. mesenterica*. This was distinguished from *T. lutescens* by more irregular, distally enlarged, more or less nodulated sterigmata. Spores about the same as in *T. lutescens* (10-12μ thick) but sprouting with much fewer projections than in the latter. (See also Tulasne in Ann. Sc. Nat. 1853, Pls. 10 and 11).

This is almost certainly *T. mesenterica* as understood by Schweinitz. A specimen from him in the Curtis Herbarium is like my plants, basidia oval, 12-4-15 x 17-18μ, surface of the plant smooth. Curtis' own specimens labelled *T. mesenterica* (Society Hill, S. C., No. 1407, on deciduous bark) are a Dacrymyces with eight-celled spores about 15.5-21.7μ long.

3895. On dead stem of Ligustrum, Rosemary Street, December 14, 1919.

3916. On a decaying oak limb, bursting through the bark, Battle's Park, December 21, 1919. Basidiospores pale yellow to orange yellow, ovate or subspherical, 7.4-9 x 8-11μ. Basidia oval, 13.7-15.5 x 18-20μ, divided into four cells by longitudinal or slanting walls. Conidiospores orange yellow, oval, 2.8-3.7 x 3.4-5μ.

4032. Decaying maple wood on Strowd's hill, January 25, 1920.

4069. On a fallen branch of Spanish oak, February 4, 1920. Spores short-elliptic, 7.4-10 x 9.3-14.8μ. Basidia oval, 14.8-16.6x16-20μ.

4108. On oak bark by Battle's branch, February 13, 1920. Hollow in part, deep orange when young.

4204. On dead oak in Tenny's ravine, March 13, 1920. Lobes hollow. Spores short-oval, 7-8.5 x 9.3-12.5μ. Many secondary ones of various sizes. Basidia oval, young ones pear-shaped, irregularly divided, 11.2-15.5 x 14-20μ.

7. **Tremella pinicola** Britz.

PLATES 41 AND 58

Orange-yellow, composed of a few thin, flat, crumpled lobes or more folded and less plate-like, not hollow, making a clump 2.5 x 1.2 cm., and 7-10 mm. high, which is pinched at the base and attached by a line; not rooted; lobes when distinct about 1 mm. thick, surface nearly or quite glabrous. Texture firmly gelatinous; flesh translucent about color of surface.

Sporidia oval or elliptic, orange-yellow, 1-2.5 x 3-5μ. Basidia subspherical to oval, 16.5-18.5 x 20-23μ, irregularly divided into four cells. Basidiospores subspherical, 10-11 x 11-12.2μ.

PLATE 41

FIG. 1. NAEMATELIA NUCLEATA. No. 4046.
FIG. 2. TREMELLA PINICOLA. No. 4050.
FIG. 3. PLATYGLOEA LAGERSTROEMIA. No. 4062.
FIG. 4. DACRYMYCES PEDUNCULATUS. No. 4185.
FIG. 5. TREMELLA LUTESCENS. No. 3895.

We refer this to *T. pinicola* Britz. because it is about the same color and size, grows on pine and has similar spores. There is nothing else at all like these on pine and it seems best to interpret it in this way at present rather than to make a new species. Only microscopic comparison with the type, if any exists, can make the determination sure. Britzelmayr's description of his species is as follows (translation): "Gelatinous, externally orange, inside clearer, sessile or with a short stalk, surface with small undulations and pits, in other respects, including the spores, similar to *T. mesenterica;* on the bark of pine, fir and larch throughout the year." (Bot. Centralb. **54**:104. 1893). I have not seen his fig. 19 in his Tremellini fascicle as it is missing in the copy at the New York Botanical Garden. *Tremella pinicola* Pk. was published earlier and would take precedence, but it is not a Tremella. (See note on p. 150).

This cannot be *T. rufolutea* from Cuba. In the Curtis Herbarium is a specimen labelled *T. rufolutea* from Cuba (Wright, No. 217). It is a resin-colored mass of considerable size, apparently solid and amorphous. It is certainly not a Tremella. (See note by Lloyd under *T. compacta* in Myc. Notes **58**:825. 1919.) No basidia could be obtained from it. Massee's notes on *T. rufolutea* seem to refer to an entirely different plant (Jour. Myc. **6**:183. 1890). It resembles most *Naematelia quercina* (No. 3935) in form and color, basidia and spores, but differs in absence of the internal white membranes and different surface. *Tremella lutescens* (No. 3895) is also very similar in form and color, but differs in the smaller spores, smaller and more elongated basidia and hollow sacs. Both differ also in growing on deciduous wood. The lobes of the present species (No. 4050) are more like folded plates (as in *T. frondosa* but to a less degree) than in the other two. *Tremella spectabilis* Möller from Brazil is of somewhat similar form and color, but has basidia 13-15μ thick and spores 5-6 x 10μ, and probably grows on deciduous wood (kind not stated) (Möller, l.c. p. 122).

Hartsville, S. C. On bark of *Pinus taeda*, December 25, 1919, (No. 4050). Coker.

8. **Tremella virens** Schw.

PLATES 23 AND 57

Forming pulpy, much convoluted, irregular, flattened, compound masses which may extend along the branch-like *Exidia glandulosa* for

a distance of 15 cm.; individual plates are centrally attached and spread out flat on the bark, about 5-10 mm. broad and 1.5-2 mm. thick except where crumpled by pressure, then at times up to 6 cm. high, with much the habit of larger masses of Naematelia; at first firmly gelatinous then softer on exposure; color amber to pale amber, with a faint olive tint, later with brownish red tints in parts; not rooting; surface glabrous, not glaucous.

Spores (of No. 4070) elliptic, smooth, light greenish-yellow under microscope, 6-7.4 x 9.3-12.9μ. Basidia oval, 12.5-14 x 15-16μ, four-parted.

That this is *T. virens* seems certain. It is different from anything else we have, grows on dogwood and, in large groups, always shows a distinctly greenish tint. It is not confined to dogwood, but is also found on oak. *Tremella virescens* Schumacher (Enum. Plant. Sæll. **2**:439. 1803) does not seem very different as understood by Brefeld. He was confused on the name of the last and treats it as "*T. virescens* n. sp. formerly *Naematelia virescens* Schm." (Brefeld l.c. p. 128, Pl. 8, figs. 25-28). *Naematelia virescens* (Schm.) Corda is supposed to be the same, but Corda speaks of the inside veined with white and figures the center pale (Icon. Fung. **3**:35, Pl. 6, fig. 90. 1839). The spores of *T. virescens* are given by Lindau as ovate, 12-15μ long; basidia olive green, 15-20μ thick (Krypt. Fl. Mark Brand. **5***a*:920. 1914).

4070. On rotting dogwood branch with bark on, February 4, 1920. Photo.
4153. On dead dogwood limb, February 22, 1920. Basidia oval, about 13-14μ thick.
4161. On decaying oak limb, February 22, 1920. Spores elliptic, smooth, pale greenish-yellow under microscope, 5.5-7.4 x 9-13μ.
4172. On dead oak limbs, February 23, 1920. Plants pale greenish amber, extending 2.5 x 15 cm. Spores subspherical to elliptic, smooth, 5.5-7.4 x 7.5-12μ, pale greenish amber under microscope.

9. **Tremella carneoalba** n. sp.

PLATES 23, 42 AND 59

Plant forming small, convoluted, flattened pustules which touch and crowd each other over considerable areas or in part may be only gregarious. Individual pustules about 1-8 mm. broad and up to 4 mm. high, wet but not viscid; color pallid white to creamy yellow and often with a distinct flesh tint so as to be more flesh color than yellow; texture firmly gelatinous.

PLATE 42

TREMELLA CARNEOALBA. No. 3877.

Spores white, spherical, variable in size, 6.3-10.2μ in diameter, smooth, sprouting soon in water to a short promycelium with an apical spore of the same shape and a little smaller. Basidia spherical to very short-oval, 14-16μ in diameter, four-celled by longitudinal walls, which are median or eccentric and often oblique, the cells often of different sizes and producing spores in proportion. Sterigmata long to very long, irregular, pointed, collapsing as well as the basidial cells as soon as the basidiospore is formed.

Distinguished by the small size, pale color and pulvinate form. The plant dries down to very inconspicuous amber-colored crusts with a thin, superficial dusting of white fibers. It revives to the original form on wetting again.

This cannot be *T. viscosa*, for that has elongated, sausage-shaped spores according to Berkeley (Ann. & Mag. Nat. Hist. 13:Pl. 15, fig. 4) and Patouillard (Tab. Analyt. No. 475). Britzelmayr gives the spores of *T. viscosa* as 5-6 x 10-12μ, but Schroeter gives them as subglobose, 11-13 x 15-17μ (see Saccardo). This looks like a confusion of species. The illustration in Flora Danica showing habit (Pl. 1851, as *Thelephora viscosa*) is very much like our plant. *Tremella candida* var. *effusa* Alb. and Schw. can hardly be this, as it is said to be ½ inch thick. If it were not for its growth on wood this could hardly be distinguished from *Sebacina caesia* Tul. as illustrated by Patouillard (Tab. Analyt. No. 681). That is said to grow on the ground. The habit sketches are almost exactly like our plant and the subspherical spores (8 x 10-12μ) sprout to a single spore of similar shape. *Exidia albida*, as illustrated in Massee's British Fungi and Lichens, Pl. 30, fig. 1, is an exact representation of our plant, even the pinkish tint being shown, but all the published spore measurements of that species agree in giving them an elongated, sausage-shape (see also notes under *T. fuciformis*).

Exidia guttata Bref. is also very similar in form and color, but is a true Exidia with the curved spores 4 x 10μ. *Tremella globulus* Bref. is small, brownish and pulvinate, but could not be this as the spores are 15-18μ in diameter. The hymenium is brownish, the inner part colorless (?) ("Weiss") (Bref. l.c. p. 126).

3877. On fallen branch of Carpinus in Arboretum, December 12, 1919. Photo. Type.

4020. On twigs of privet on the bush in President's yard, January 24, 1920. Typical *Exidia glandulosa* was abundant on the same twig and crowded the Tremella in places.

4022. On Robinia twigs on tree, January 24, 1920. Color watery milk with a faint pink tint. Spores 7-9.7μ in diameter, spherical (spore print on slide), many budding and sending out promycelia to form a spore of the same shape on the end just as in No. 3877.

10. **Tremella subanomala** n. sp.

PLATE 58

Pulvinate, convoluted, forming an apparently compound tuft 4 x 6 mm. and about 1.5 mm. thick; color pallid brown to wine-brown; the surface appearing minutely granular under a lens; texture very firmly gelatinous, harder than any other species; bursting through the bark.

Spores subspherical, remarkable in being compressed a little at right angles to the mucro, 7.4-10μ in diameter, a few up to 11μ. Basidia subspherical, a few oval or pyriform, not collapsing when emptied, four-celled by longitudinal divisions, 13-17μ thick.

This is like a plant on alder labelled *T. bulgaroides* E. & E. from Canada (Macoun) at the New York Botanical Garden, but I cannot find that this name was ever published. It is nearest *Tremella carneoalba* which differs in pinkish-white color, more gregarious growth, and basidia that collapse after forming spores. It is not unlike *T. anomala* Möller (l.c. p. 120) in size, form, and color (up to 0.5 x 1.5 cm.; color smoky-yellow), but that has basidia 10μ thick and spores 6μ thick.

4005. Dead Alnus twigs by Battle's branch, growing with Cyphella, January 22, 1920. Type.

11. **Tremella moriformis** Smith.

T. colorata Pk.

This has so far not been reported from North Carolina (except by Curtis as *D. moriformis*, probably from the S. C. collection by Ravenel), but it almost certainly occurs in the state and should be looked for. I have prepared the following description from the good type specimens of *T. colorata* Pk., from a collection of *T. moriformis* from Bresadola (on Robinia from the Trentino) and from a collection from South Carolina in the Curtis Herbarium (Ravenel). See Sowerby's English Botany 36:2446. 1812.

Plant forming irregular, more or less anastomosing, pulvinate patches extending more or less densely for several cms. on the wood,

individual patches tending to take an elliptic form like half of a football. Surface granular and irregular, not typically convoluted; the outer layer nearly black, quite tough and forming a kind of crust; the inner tissue more gelatinous and a lighter purple under the microscope; hyphal threads with numerous clamp connections, each thread distinctly purplish. Basidia near the surface, subspherical to oval, 12-14.5μ thick, colorless when young, purple when mature, divided often irregularly into four cells. Spores said by Peck to be color of hymenium when mature, globose, 12.7-17.7μ in diameter. His figures are evidently wrong, and he probably took the younger basidia for spores. We have not been able to be sure of the spores in any of the herbarium specimens examined. Spore-like material present was badly mixed and much collapsed.

If a true Tremella, this species is evidently an aberrant one. It is easily recognized by the blackish-purple color, practically black in herbarium specimens except under the microscope.

We include the following notes for the convenience of students:

Tremella tremelloides (Berk.) Mass. (*Sparassis tremelloides* Berk.). The following is adapted from Massee (Jour. Myc. 5:184, Pl.14, fig. 1. 1889). Tremelloid, lobes fasciculate, elongated, suberect, almost free to the base or variously united, compressed, springing from a small contracted base, surface scabrid, dull orange; spores elliptic-oblong with a minute oblique apiculus at the base, 11-12 x 5μ. On wood, Lower Carolina (Type in Herb. Berk., Kew). Forming large tremelloid tufts, always springing from a very small basal portion which penetrates the matrix; lobes suberect, 3-4 inches high in well grown specimens, sometimes smaller, in some specimens variously plicate and almost free to the base; in others the lobes are united laterally and form a gyrose tuft, always much compressed. The distinctly scabrid surface is very characteristic, and is due to thickly scattered papillae, which give a very harsh feel to dry specimens. Basidia large, sterigmata developed in succession. From Massee's figure of the spores this is probably an Exidia.

Tremella gigantea B. & Cooke, is, according to Massee, a gelatinous lichen (Jour. *Myc.* 6: 182. 1890).

Tremella rufolutea B. & C. See my note under *T. pinicola*, also see Massee (Jour. Myc. 6: 183. 1890).

Tremella enata B. & C. is represented in the Curtis Herbarium by No. 2456 on oak from Society Hill, S. C., a number mentioned in the original description. On examining it I found nothing to indicate that it is either a Tremella or a Dacrymyces. It is apparently not related to either. Massee, however, has studied the other number mentioned in the original description, No. 4307, at

Kew, and thinks it a Dacrymyces. We adapt the following from his description: (Jour. Myc. 6:182, Pl.7, figs. 14-17. 1890): Erumpent; dark amber, appressed, surface slightly rugulose, or almost smooth, bounded by the ruptured bark, up to 1 centimeter diameter; basidia cylindrical, bifurcate at the apex, 45-50 x 5μ; spores elliptic-oblong, colorless, with an oblique apiculus at the base, slightly curved, 10-11 x 3.5μ. Superficially resembling a small discolored form of *Tremella albida*, but a true Dacrymyces. From 3 millimetres to 1 centimetre across. On *Alnus serrulata* and oak, Lower Carolina.

Tremella myricae Berk. & Cooke. The following is adapted from Massee (Jour. Myc. 6: 182. 1890): Foliaceo-gyrose, gelatinoso-elastic, semi-pellucid, smoky gray, when dry blackish with a tinge of purple here and there, surface with minute, scattered points; spores broadly elliptic, with an oblique apiculus, 8-9 x 6-7μ, colorless. Forming thin, foliaceous expansions when dry, 1-4 centimeters across. The minutely scabrid surface when dry is characteristic. On bark of Myrica and Persea, Gainesville, Fla. (Rav.).

Tremella dependens B. & C. The following is from Massee (Jour. Myc. 6: 183. 1890): Pendulous, elongato-clavate, attached by a slender stem-like base, mucilaginous, pale dingy yellow, the central portion consisting of exceedingly thin hyphae immersed in mucilage; towards the even surface the hyphae become thicker and form a compact layer which produces basidia at every part of the surface; basidia spherical with four elongated sterigmata; spores elliptic-oblong, smooth, colorless, 7 x 3-3.5μ. Hanging down from underside of rotten poplar (Liriodendron) logs after rain, Alabama. Peters.

Tremella stippitata Pk. (Rep. 27; 100. 1875) is a Coryne. He also reports *T. enata* B. & C. (l. c. p. 100).

Phaeotremella pseudofoliacea Rea. (Trans. Brit. Myc. Soc. 3:377. 1912). This genus is based apparently only on the umbrinous spores (which are obovate, 12 x 9-12μ). The plant looks much like our *Naematelia quercina* in external form, and the spores are about the same.

Exidia scutellaeforme B. & C. In the Curtis Herbarium is a specimen of this from Alabama (Peters No. 1093: Curtis No. 6343. Type?) The dried plants are black and look like *E. glandulosa*. In Dr. Farlow's writing is the note: "Basidia are vertically 4-parted."

Exidia pinicola (Pk) (Rep. 39, p. 44. 1886 as Tremella). Peck's description is: "Pulvinate, gyrose-plicate, somewhat lobed and lacunose, raisin-colored when moist, blackish when dry, filaments slender, branched; spores oblong, curved, colorless, .0005 in. long, .0002 broad. Dead branches of pine, July."

We have examined the type and find the color as described; basidia oval or pear-shaped, 4-parted, 9.3-10.3μ thick; spores curved-elliptic, smooth, 3.7-4 x 9.5-11.1μ. This evidently throws the plant into the genus Exidia, and it seems nearest *E. gelatinosa*. The surface appearance is that of a crowded colony of very small individuals of *E. gelatinosa*, and is not at all cerebriform. It may be easily recognized by the raisin-color, small flat plates around sunken chambers and growth on pine. The texture is toughly gelatinous. It may well be that this is the same as *E.umbrinella* Bres. which grows on conifers, is said to be near *E. recisa*, and has spores 3-4 x 11-14μ, basidia 8-9 x 10-12μ (Fung. Trident. 2:98, Pl. 209, fig. 2. 1900).

The following are translations of Schweinitz's original descriptions of species of Exidia and Tremella with notes added by us:

Exidia lurida Schw. (No. 1100. Syn. Fung. Amer. Bor p: 185: 1832) "Effused gyrose-plicate, pale, circular; rather thick. Shrunken on drying. Dotted over with a few papillae. It occurs here and there on branches of *Celastrus*, Bethlehem." A plant in the Schweinitz Herbarium has the general aspect of *E. gelatinosa* but seems different in the absence of scurfy particles. A preparation showed basidia of the Exidia type.

Exidia spiculata Schw. (No. 1101. Syn. Fung. Amer. Bor. p. 185:) "Adpressed, effused, thick-lobed, rough, wrinkled, olivaceous-green, very slightly shrunken on drying, but black in color. Papillae frequent on the upper side; margin divided into small obtuse lobes. Rather rare on the cut surface of trunks of *Platanus*, Bethlehem." On examination the type showed no papillae when wet; dark, effused, crumpled, extensive. Not shrunken to a membrane. A slide revealed no facts of value.

Exidia applanata Schw. (No. 1102. Syn. Fung. Amer. Bor. p. 185.) "Applanate-expanded, closely adpressed, margin at length subfree, oblong in shape, moderately thick, 2-3 lines long; drying black and somewhat pulverulent-scurfy; marked on the surface with a few wrinkles or veins. Papillae scattered. On the inner bark of *Rhus glabra*, Bethlehem." This may be *E. glandulosa* but a slide from the type showed no characters of value.

Tremella crenata Schw. (No. 1141. Syn. Fung. Car. Sup. p. 89: 1822). "Rather large, thick, wavy-applanate, ribbed, fuscous brown; margin beautifully crenate. Occasional on branches." This is *E. gelatinosa.*

Tremella crassiloba Schw. (No. 1112. Syn. Fung. Amer. Bor. p. 185.) "Erumpent, firm, with thick, fleshy-tremellose, rounded white lobes forming a globose mass. In the wet state, surface apparently squamulose; when dry, black and pulverulent. Bursting forth from fallen branches, Bethlehem." A specimen in the Schweinitz Herbarium shows low, black, pulvinate, somewhat uneven warts about 1-1.5 mm. broad, coming through small holes in the bark of deciduous branches; when wet becoming murky clay-color and gelatinous, about consistency of *Exidia glandulosa* but does not seem to be that or *E. recisa.* There are no papillae and the surface is not obviously granulose. Basidia subspherical, 4-celled, 11-13μ in diameter.

Tremella corrugata Schw. (No. 1113. Syn. Fung. Amer. Bor. p. 185.) "Cespitose, corrugated, with rather thin, flabby lobes, margin elevated, veiny; blackish-purple in color. Sub-squamulose in the dry state. An inch in diameter. Rare on wood and branches, Bethlehem." This is *Exidia gelatinosa.*

Tremella palmata Schw. (No. 1117. Syn. Fung. Amer. Bor. p. 186.) "Rooted, penetrating the wood with a tomentose root. Stem compressed; palmately expanded, horny when dry, of elegant golden color, sub-diaphanous, apex capitulate, gyrose-plicate, compressed and dilated; the head confluent with the stem. In form and habit related to *Cantharellus spathularia*, n. 292, on dead wood, Bethlehem." This looks much like *Ditiola radicata* from the specimen in the Schweinitz Herbarium, but I could get very little from a preparation made from it.

TREMELLODON

Plants gelatinous, translucent, whitish to light or dark-brown, more or less stalked, the top expanded and bent over, with short teeth on the underside. Basidia longitudinally divided into four parts with four sterigmata. Spores smooth, white, spherical. We have but one species which when large would be taken at first sight for a Hydnum except for the gelatinous texture.

Tremellodon gelatinosum (Scop.) Pers.

PLATES 43 AND 59

Plants upright, petaloid and bent over at top to form a one-sided cap under which the small spines hang down; height from 2-7 cm., breadth at top up to 7 cm., at base about 1.5-2.5 cm.; color of cap surface usually from light to dark brown, in drying becoming darker and blackish in places; rarely the whole plant may be a pure soaked white, in age the upper part becoming a light pinkish buff; in darker plants the brown may be slightly tinted with blue or violet; surface, except spines, covered with minute papillae with some wrinkles on the posterior side near the base. Flesh gelatinous, watery and translucent, but firm and tough.

Spines gelatinous, white, confined to the underside of the cap, up to 2.5 mm. long, the spores being borne only on their proximal half or two-thirds. No spores are borne except on the spines.

Basidia short, pear-shaped, 10.3μ in diameter with four stout sterigmata. Spores white, spherical, about 6.5μ in diameter.

This is a remarkable and interesting plant, having the spines of a Hydnum and the texture and basidia of a Tremella. It is found on decaying pine and is rare. It is said by McIlvaine to be edible and delicious when slowly stewed. For illustrations in color, see Schaeffer, Pl. 144; Krombholz, Pl. 50, figs. 18-22; Richon & Roze, Pl. 65, figs. 12-17; Gillet, Pl. 661 (124). See note in Mycologia 12: 142. 1920.

912. On a pine log, October 11, 1913. Photo and drawings.
2954. From inside decaying pine stump, woods south of athletic field, December 1, 1917. Photo.
2956. From side decaying pine stump, Strowd's pasture by Bowlin's Creek, December 3, 1917.
4034. On pine log on Strowd's hill, January 25, 1920.
4092. On pine log back of athletic field, February 8, 1920.

PLATE 43

TREMELLODON GELATINOSUM. No. 2954.

TREMELLODENDRON

A remarkable genus, growing on the ground in woods and resembling stipitate species of Thelephora in habit, form and texture, but with the basidia divided into four parts by longitudinal septa, as in the Tremellaceae, and having the spores smooth, white and elongated. The genus was established by Atkinson (Journal Mycology 8:106. 1902), and the species have been treated by Burt (Ann. Mo. Bot. Gard. 2:731. 1915).

KEY TO THE SPECIES

Plant whitish, much branched, the stems or branches or both fusing where coming together.
- Stout and often large and heavy ..... *T. candidum* (1)
- Delicate, the branches slender and numerous ..... *T. merismatoides* (2)

Plant whitish, slender, little branched, the stems single and not fused with others ..... *T. Cladonia* (3)

Plant simple, orange colored ..... *T. aurantium* (4)

1. **Tremellodendron candidum** (Schw.) Atk.

PLATES 44 AND 59

Plant upright, centrally stalked, densely branched, the clumps reaching a diameter of 8 cm. and a height of 6 cm., but usually much smaller. The base is a fused mass which soon branches into more or less distinct, but often confluent upright stalks which subdivide into more or less flat and often laterally fused branches, these terminate in fibrous or decidedly fimbriated, bluntish tips, which are nearly or quite white, the remainder of the plant being a creamy or sordid white. The texture is very tough, almost woody below and is not at all brittle.

Basidia four-celled by longitudinal septa; spores (of No. 1385) white, elliptic, with mucro, smooth, with large or small oil drops, very oily as seen by the many oil drops in the water, 4.8-6.6 x 8.5-13μ.

A very abundant plant in woods and lawns and very variable in size and stoutness.

Burt recognizes *T. pallidum* as the larger, more solid forms I here include under *T. candidum*. I cannot see good grounds for recognizing more than two species here. We have many intermediate forms and sizes. I am also not sure that *T. merismatoides* is different, but am including it as a convenient name for the most delicate, Pterula-like form.

352. Mixed woods, damp low place, growing on ground, October 20, 1910.
648. On hillside east of Howell's branch, October 29, 1912.
695. In mossy grass in middle of campus, June 15, 1913.
1385. In old Raleigh road, just north of Piney Prospect, October 19, 1914. Photo.
1386. By Battle's branch, September 25, 1913.
2245. Forming a partial fairy ring of very fine plants, swamp of New Hope Creek, below Durham-Chapel Hill bridge, June 24, 1916.
2420. Deciduous woods, Battle's Park, July 22, 1916. Spores 4.5-6 x 7.7-11.1μ. These are typical, stout, large plants.

North Carolina. Schweinitz.
North Carolina. Atkinson.

2. **Tremellodendron merismatoides** (Schw.) Burt.

PLATE 45

Plant 2.5-3.8 cm. high, in compound clusters about 2-3 cm. broad above, with several partly fused stalks and very many delicate, only slightly fused branches; white and tough.

Spores (of No. 2324) smooth, elliptic, some bent, 4.8-6.6 x 7.4-11μ.

The more delicate forms of *T. candidum* approach this, but we have found none close enough to it to make a complete gradation and it may be a good species, as considered by Burt. The spores are exactly like those of *T. candidum* in appearance; in our one collection they run a little shorter than in No. 1385, but no shorter than in No. 2420, which are typical large plants.

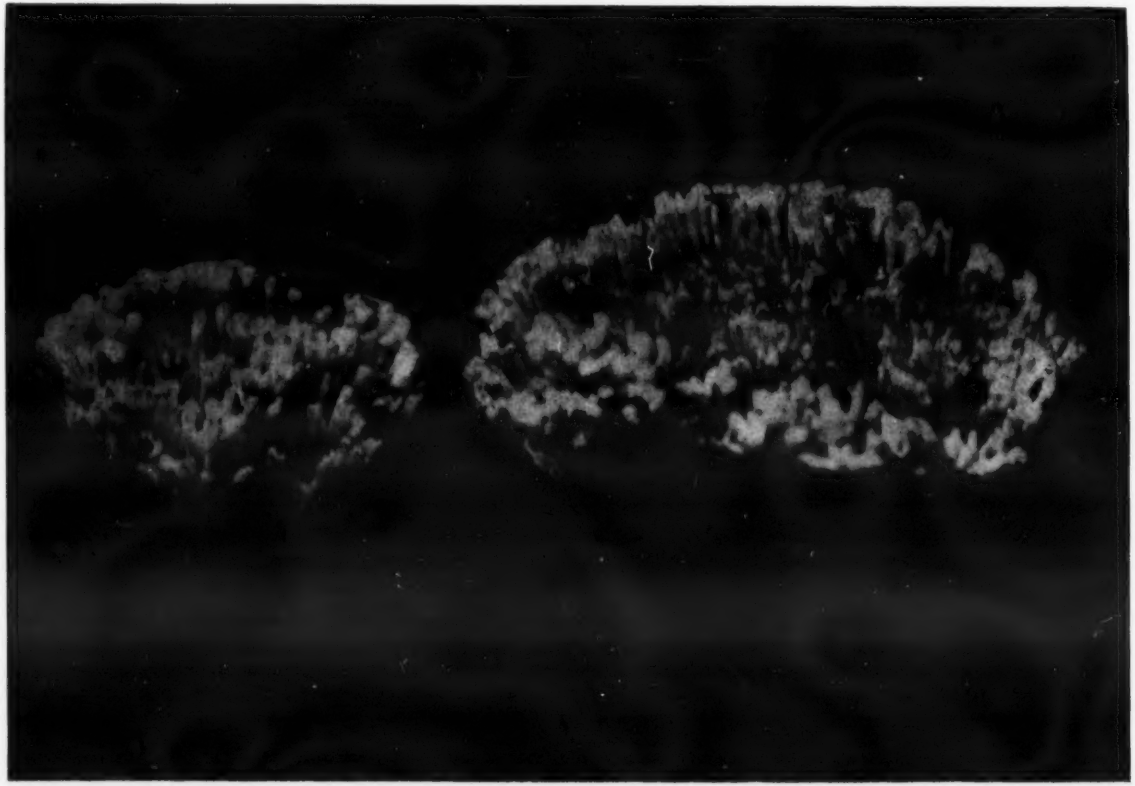
2324. In sandy humus, deciduous woods by western branch of Meeting of the Waters, June 30, 1916. Photo.

3. **Tremellodendron Cladonia** (Schw.) Burt.

We have not found this and adapt the following from Burt (l.c. 2:738. 1915):

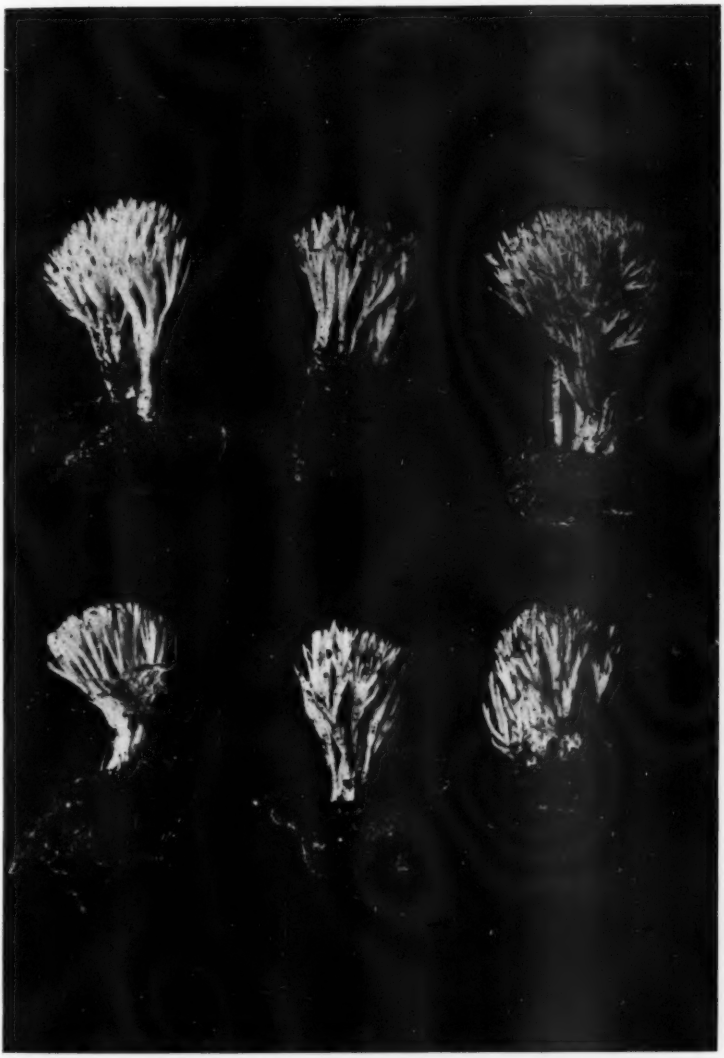
Plant 2.5-5 cm. high, 0.7-2 cm. broad; stem about 1.5 mm. thick; solitary or gregarious, erect, coriaceous-soft, pallid, drying warm buff, sometimes with the older portions pale olive-gray, stipitate; stem cylindric, palmately branched into a few—often three—cylindric branches, each or some of which occasionally branch again in similar manner; branches arranged in a plane from flattened end of stem or branch or in a circle about the cylindric end of the stem which is then sometimes perforate and the branches often channelled; hymenium amphigenous, or inferior when the branch is channelled; basidia

PLATE 44



TREMELLODENDRON CANDIDUM. No. 1385.

PLATE 45



TREMELLODENDRON MERISMATOIDES. No. 2524.

longitudinally septate, pyriform, 9 x 15μ; spores colorless, simple, even, curved, 4.5-6 x 9-15μ. On ground in woods. Canada to Mississippi and westward to Missouri. August and September.

Blowing Rock. Atkinson.
North Carolina. Schweinitz.

4. **Tremellodendron aurantium** Atk.

This was described from Blowing Rock, N. C., by Atkinson and has not been found since. We give below the original description (Ann. Mycologici **6**:59. 1908):

"Plants simple, slender, 1-3 cm. long 2-3 mm. stout, dark orange, tough. Basidia subglobose, 10-12μ, longitudinally divided; sterigmata 4, long, slender, flexuous. Spores, oboval-subelliptical, granular, then with an oil drop, 7-10 x 5-6μ, white, hyaline."

Blowing Rock. Atkinson.

EICHLERIELLA

Plant forming small, adherent patches with the margin free and often a little bracketed, rarely attached only by the center; texture tought, coriaceous or leathery, dry or rarely waxy. Basidia ovate, divided into four cells by longitudinal divisions. Spores long, curved, smooth, white. The genus resembles Corticium or Stereum or Cyphella except for the four-celled, ovate basidia. We have but one species, the only one recorded from this state. See Burt, Ann. Mo. Bot. Gard. 2:743. 1915.

Eichleriella Leveilliana (B. & C.) Burt.
Corticium Leveillianum B. & C.
Stereum Leveillianum B. & C.

PLATES 46 AND 59

Plant forming subcircular, mostly resupinate patches about 3.7 mm. wide, with a narrow, free margin which may curve outward on the upper side for about 1-1.5 mm. if the substratum is vertical; dorsal surface of the shelving margin tomentose, nearly white to light or dark gray depending on exposure, scarcely zonate. Hymenium a clear, light rosy pink, fading to nearly white in areas or all over when old. The thickish, blunt margin is sharply determinate, and tends to

become somewhat free all around. Texture leathery and pliable, not brittle when dry. In this lot of numerous patches one plant, emerging from a lenticel, was attached by only a point eccentrically placed, all the rest of the cap being free. When young the plant appears as a little peltate disc, but this soon expands and except for the free margin attaches itself to the bark as it grows.

Basidia like those of a Tremella, ovate, four-celled by longitudinal divisions, 9.3 x 18μ, sterigmata long. Slender branched threads grow up densely beyond the basidia to form the hymenial surface. Spores white, smooth, bent, sausage-shaped, 4-5.5 x 12.5-17.3μ.

This is a remarkable plant and was first described from South Carolina as a Corticium. It would be referred at once to Corticium or Stereum if it were not for the peculiar basidia. The pretty, delicate rosy color is preserved in drying.

3829. On sweet gum (Liquidamber) twigs, back of Peabody Building. December 6, 1919. Photo.

3953. On frondose twigs on grape arbor, January 17, 1920.

SEBACINA

Resupinate, on bark or wood as in Corticium or encrusting herbaceous stems or mossy tree bases from the ground; texture various, waxy to leathery or coriaceous; basidia ovate and longitudinally septate as in Tremella; spores white, smooth, mostly enlongated and bent or flattened on one side (in *S. cenerea* Bres. they are said by Bresadola to be subglobose, 12-13 x 12-15μ, in *S. caesia* Tul. they are given by Patouillard (Tab. Analyt. No. 681) as ovoid, 8 x 10-12μ). We have found four species in Chapel Hill and two others are reported from the state. See Burt. Ann. Mo. Bot. Gard. 2:749. 1915. Of the four species we have found only one can be distinguished in Burt's monograph. We have tried to determine the other three from the European literature, but not having been able to do so as yet have decided to let them go unnamed until we become more familiar with the genus. Burt has seen our plants, but has not cared to give a positive opinion from the material sent. All our figures are from fresh material and the spore characters taken from good spore prints.

KEY TO THE SPECIES

Diffused as a thin or thickish crust on dead wood, with the habit of a Corticium.

Plant up to 1 or 1.5 mm. thick; spores 6.3-9 x 7.7-12.2μ ..... *S.* sp. (No. 4116) (2)

PLATE 46

EICHLERIELLA LEVEILLIANA. No. 3829 (right).
SEBACINA CALCEA. No. 3963 (left).

Plant much thinner, color nearly white to creamy or pale slate
Spores 4.8-6.3 x 14.5-18μ ..... *S. calcea* (1)
Spores 3.5-4 x 5.5-8.5μ; basidia near the surface ..... *S. sp.* (No. 4118) (3)
Spores 3.7-4.5 x 6-9.5μ; basidia more deeply seated ..... *S.* sp. (No. 4119) (4)
Growing from the ground and running up and encrusting the bases of living or lifeless objects; color buff
Sometimes with branches or flaps; hymenial layer 60-150μ thick ..... *S. incrustans* (5)
Without branches or flaps; hymenial layer 200-300μ thick ..... *S. Helveloides* (6)

1. **Sebacina calcea** (Pers.) Bresadola

PLATES 46 AND 60

Entirely resupinate, closely attached, forming elongated and anastomosing patches from very small up to about 5-6 cm. long and 6 mm. wide, very thin, only about 50-110μ thick; surface minutely pulverulent, dull, the closely adnate, well-defined margin white, the remainder very light drab gray. Substance sub-gelatinous or subfleshy, not to be removed in flakes.

Spores white, rod-elliptic, bent, 4.8-6.3 x 14.5-18μ, a few as short as 11.5μ. Basidia subspherical, 13-14μ thick, divided into four cells by longitudinal divisions; sterigmata long, thickish in the distal half; paraphyses forming a transparent, almost structureless, layer above the basidia, their finely branched tips loaded with crystals.

This agrees well with *S. calcea* as described by Bresadola and by Burt. It is said to grow on both coniferous and frondose trees. In the southern states it has been reported only from Georgia.

3963. On a dead branch of *Robinia pseudacacia* in Arboretum, January 12, 1920.

2. **Sebacina** sp. ?

PLATES 47 AND 61

Forming low, crowded and anastomosing, nodulated masses and pustules looking very like a mixomycete; patches 9 cm. or more long and up to 1.5 cm. wide in our collection (probably quite indefinite as to size and form of area covered); thickness up to 1 or 1.5 mm.; color a pallid creamy yellow or dusky cream; surface glabrous, shining unless getting rather dry. Texture succulent but not gelatinous

in the usual sense, but firmly waxy. Fibers of the flesh slender and regular, about 1.5-2μ thick, sparingly branched.

Spores oval, flattened on one side, yellowish under microscope, very variable in size, 6.3-9 x 7.7-12.2μ, sprouting into threads by one or two germ tubes, which may arise at any point. Basidia oval, 13.7-14.4 x 16.3μ, irregularly four-celled, collapsed soon after formation of spores. Sterigmata much thickened upward, some very long and slender. Paraphyses slender, densely packed, curved over and mostly branched a little at the ends, the branches crooked and more slender and set with very minute crystals. Much larger, roughly globular or angular crystals with slender, spine-like hyaline projections also occur rather abundantly through the hymenium; they are mostly about 7-9μ thick.

This species is markedly distinct from all others we have seen. The peculiar color, pustulate, anastomosing form, plump spores and large crystals separate it easily from our other Sebacinas. The projections on the crystals do not seem to be of the same nature as the crystals themselves and after drying reappear very obscurely if at all. They may be the stubs of hyphae that took part in the formation of the crystals. So thickly interwoven are the tips of the paraphyses and so dense the little crystals that there is formed a distinct and darker crust over the surface. We place this in Sebacina rather than Tremella because of the waxy texture, abundant, branched paraphyses and abundant crystals. Exidia is excluded by the plump spores.

4116. On underside of old, hard heart of an oak branch, on ground, west of athletic field, February 13, 1920.

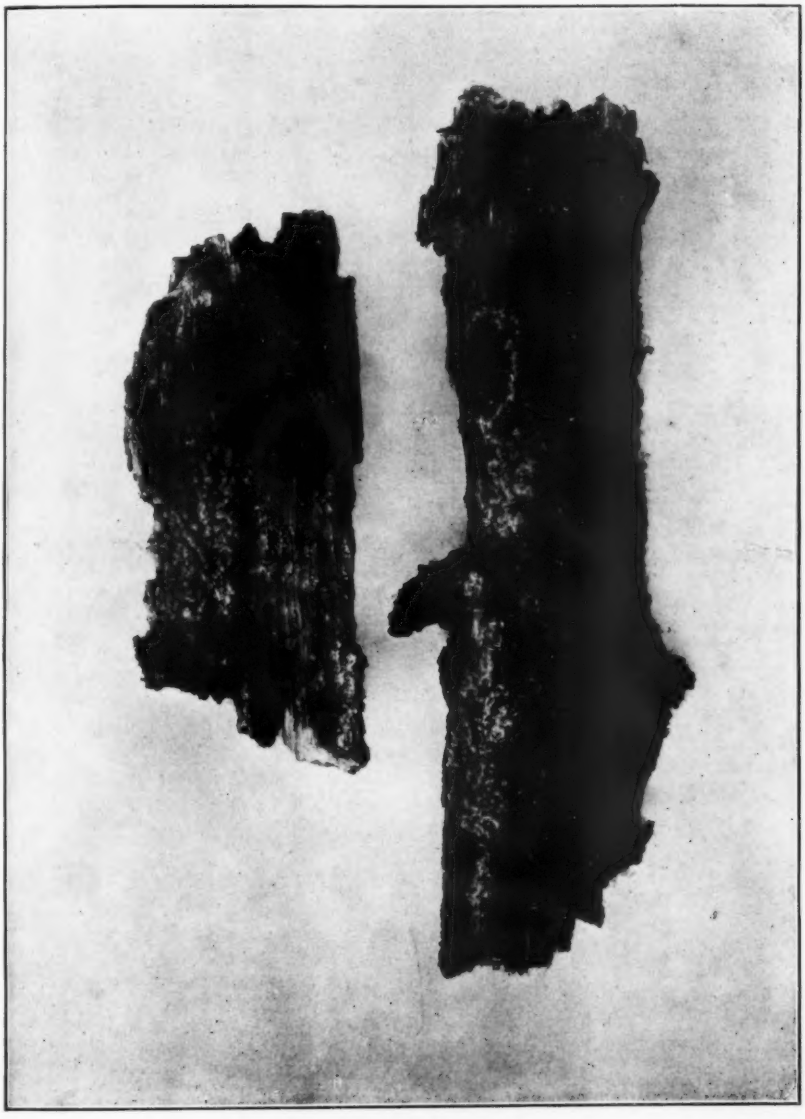
3. Sebacina. sp. ?

PLATE 60

Plant forming a thin, extended membrane about 150μ thick which is nearly smooth or obscurely nodulated and closely adherent to the wood, the margin quite indefinite; surface dull, color a pallid milky slate with a faint tint of lavender or flesh; texture waxy; threads of context closely packed.

Spores (of No. 4118, print) white, smooth, elliptic, 3.5-4 x 5.5-8.5μ. Basidia four-celled, 7.4μ thick, ovate, situated near the surface (in some cases nearer than shown in the drawing). Paraphyses not highly specialized or branched, covered with crystals through the upper layer, parallel, upright and closely packed.

PLATE 47



SEBACINA SP. No. 4116.

In drying the membrane shrinks much, to an almost invisible film; differs from No. 4119 in slate color, smaller basidia which are near the surface, and in the closely packed threads of the flesh. Our plant agrees rather closely with Burt's description of *S. podlachica* Bres. in color, size of basidia and spores, position of basidia and closely crowded threads of the context; but he does not mention the crystals in the hymenium or refer to the species on seeing our plant.

4118. On decaying underside of piece of decorticated oak wood, New Hope Creek, February 14, 1920. Drawing.

4. **Sebacina** sp. ?

PLATE 60

Plant variable in thickness, usually about 400-500μ thick except where nodulated or wrinkled, much thinner in areas; forming an extensive slick membrane with indefinite margin, usually between bark and wood and between layers of the rotten wood, sometimes on surface also of the rotten bark; color pallid straw or clay or dull whitish; surface smooth, or nodulated and irregularly pitted and wrinkled; texture waxy, not very tough or elastic; threads of context loosely packed. The plant is not removable from the wood when fresh without breaking it into pieces.

Spores (of No. 4119, print) white, smooth, elliptic, 3.7-4.5 x 6-9.5μ. Basidia oval, four-celled, 7.8 x 11μ. Paraphyses upright, closely packed, branched near the surface into a few crooked forks on which are small crystals.

4119. On decaying gum wood, near New Hope Creek, February 14, 1920. Drawing.

5. **Sebacina incrustans** (Pers.) Tulasne

We have not yet found this in Chapel Hill, but it probably occurs here. It forms an irregular fleshy-leathery, buff crust which creeps up and around the bases of objects, often on grasses. Spores white, 6-8 x 12-14μ. For a full description see Burt. l.c. p. 752. See also a photo by Lloyd in Myc. Notes **52**: fig. 1115. 1917.

Asheville. Beardslee.

6. **Sebacina Helvelloides** (Schw.) Burt.

This is much like *S. incrustans*, but differs in its less fleshy structure and thicker hymenium. It grows on the ground among mosses

and on bark at the bases of trees. It was originally described from North Carolina by Schweinitz as a Thelephora. See Burt. l.c. p. 756, for a full description.

Salem. Schweinitz.

DACRYMYCETACEAE

Small plants growing on wood; texture gelatinous and soft or toughish-gelatinous to more or less cartilaginous; form various, upright and single or branched like a Clavaria (as in species of Calocera), or forming simple or complicated little cushions which may be smooth or much folded or more or less flattened (as in Dacrymyces) or somewhat cup-shaped or spathulate (as in Guepinia). The important distinctions are microscopic and are based on the basidia and spores. The former are branched above into two long, thick sterigmata which gradually taper to the pointed ends where the two spores are borne. The color of the plants is usually yellow or orange, and they are some times viscid. Spores smooth, elliptic, usually bent, divided across into two or more cells at least before sprouting, orange or creamy yellow. See Brefeld: *Untersurchungen aus dem Gesamtgebiete der Mykologie* 7:138. 1888. Also see Tulasne, as cited under Tremellaceae.

KEY TO THE GENERA

Plants sessile, gelatinous, pulvinate, the surface convoluted; spores divided into four or more cells before sprouting ..... *Dacrymyces*

Plants with a smooth, gelatinous stalk, swollen above into a convoluted head which bears the hymenium; spores as in Dacrymyces..... *Dacryomitra*

Plants with a short, subcartilaginous stalk, the small head rounded or flattened horizontally like a carpet tack and little if at all convoluted..... *Dacryopsis*

Plants stalked, upright, spathulate, or cup-shaped, or petalloid; tough, the sterile stalk pubescent; spores divided into two cells before sprouting..... *Guepinia*

Plants stalked or subsessile by a central point, enlarged above, fleshy-tough, the hymenium gelatinous; spores divided into two cells before sprouting..... *Ditiola*

Plants stalked, upright, slender, simple or branched like Clavaria, toughish and usually viscid; stalk not pubescent; spores divided into two cells before sprouting.... *Calocera*

DACRYMYCES

Gelatinous, sessile, pulvinate, subhemispheric or flattened, usually convoluted on the surface like a brain, the entire exposed surface

covered by the hymenium, in several species with a distinct toughish root. Basidia narrow, elongated, divided at the end into two long forks which bear one spore each on distinct sterigmata. Spores yellow or orange, curved-elliptic like a sausage or one side curved, divided into cells by cross walls before sprouting. Small conidia often produced by the sprouting spores and on the surface of the young fruiting bodies. For development of basidia and other cytology see Wager in The Naturalist **695**:364. 1914.

KEY TO THE SPECIES*

Growing on pine
- Not rooted, small, watery orange or amber, or paler; nearly always on decorticated wood; spores mostly over 18μ long, divided into about eight cells before sprouting ..... *D. abietinus* (1)
- Rooted, on wood with bark on
  - Bright yellow or orange, drying red and rounded; spores 18-22μ or longer, divided into about eight cells ..... *D. aurantius* (2)
  - Pale smoky or watery amber; spores 10-13μ long ..... *D. pallidus* (7)
  - Raisin-colored, spores 21-27μ long ..... *D. pedunculatus* (4)
- Rooted on decorticated wood; drying dull red-brown, and flattened; spores 13-18.5μ, long, divided into about four cells ..... *D. involutus* (3)

Growing on deciduous plants
- Orange or wine-color or paler; rooted, drying reddish, spores 10.5-15μ long, divided into four cells ..... *D. Ellisii* (5)
  - Small, mostly yellow with an olive tint when young, drying a dull amber color ..... *D. minor* (6)
  - Small and very inconspicious, smoky-brown; drying blackish-brown ..... *D. fuscominus* (8)

1. **Dacrymyces abietinus** (Pers.) Schroeter

D. stillatus Nees

PLATES 23 AND 63

Plant forming little pustules varying from less than one mm. to about 3-4 mm. broad, and 1-2 mm. high, gregarious or touching so as to form larger compound masses; color watery-orange or amber or fading to paler yellowish or sordid or sub-hyaline; surface feeling wet, but not viscid; not passing into the wood by a tough white root (as in *D. Ellisii* and *D. aurantius*, but apparently seated directly on the wood by the central part of the underside; texture gelatinous, but holding its shape well unless very wet and then often collapsing to a

* See notes on other species, pages 172-174.

soft, shapeless jelly; no taste or odor; flesh concolorous. In drying fading down to small amber or raisin-colored droplets.

Spores (of No. 3832, spore print) deep orange, smooth, long-elliptic, mostly bent, 5.5-7.4 x 18.5-25.9μ, not divided into cells when first shed as a spore print, but later (in about a week) divided into about eight cells. Basidia forked into two long prongs.

Common on decorticated pine and cedar wood. This differs from *D. Ellisii* in the much longer spores with more numerous cells. From the good description by Persoon (Obs. Myc., p. 78. 1796) there can be no doubt that we have his plant. It is more than likely that *D. stillatus* Nees is the same, but he did not say that it grew on coniferous wood. His figure is tolerably good for our plant (Syst. d. Pilze, p. 89 (18), Pl. 22, 1858). Plants in the Curtis Herbarium under the latter name from Alabama (Peters) and South Carolina (Ravenel and Curtis) are like our plants, but specimens from Fries so labelled in the Curtis Herbarium are doubtfully the same and seem rooted (no spores to be found). Fries says that *D. tortus* grows on rotten pine wood and refers to Bulliard's *T. deliquescens* as the same. This has led to the impression that *D. deliquescens* grows on pine, a supposition which to me is more than doubtful (see remarks under *D. minor*). In the Curtis Herbarium are collections called *D. tortus* on pine and Taxodium from Society Hill, S. C. (Curtis), also one from Ravenel. These all seem to be the same as my plant. Karsten gives the spores of *D. stillatus* as 18-22 x 8μ; Hennings (Engler and Prantl, Pflanzenfamilien) as 18-28 x 8-12μ. *Dacrymyces involutus*, also on pine, has shorter spores, is rooted, and is otherwise quite different. Brefeld's conception of *D. stillatus* would exclude our plant. He has it on corticated coniferous wood (often on *P. sylvestris*), bursting through the bark in lines, more reddish than in his *D. deliquescens*, having a firm white root in the bark; spores large, 8-10-celled, 12 x 25-30μ. His plant is evidently near our *D. aurantius* Schw. if not the same.

3832. On decorticated pine logs south of athletic field, December 7, 1919. Photo.

3956. On a pine rafter on a grape arbor, January 17, 1920. Spores 5.5-7 x 15-20μ, mostly divided into about eight cells.

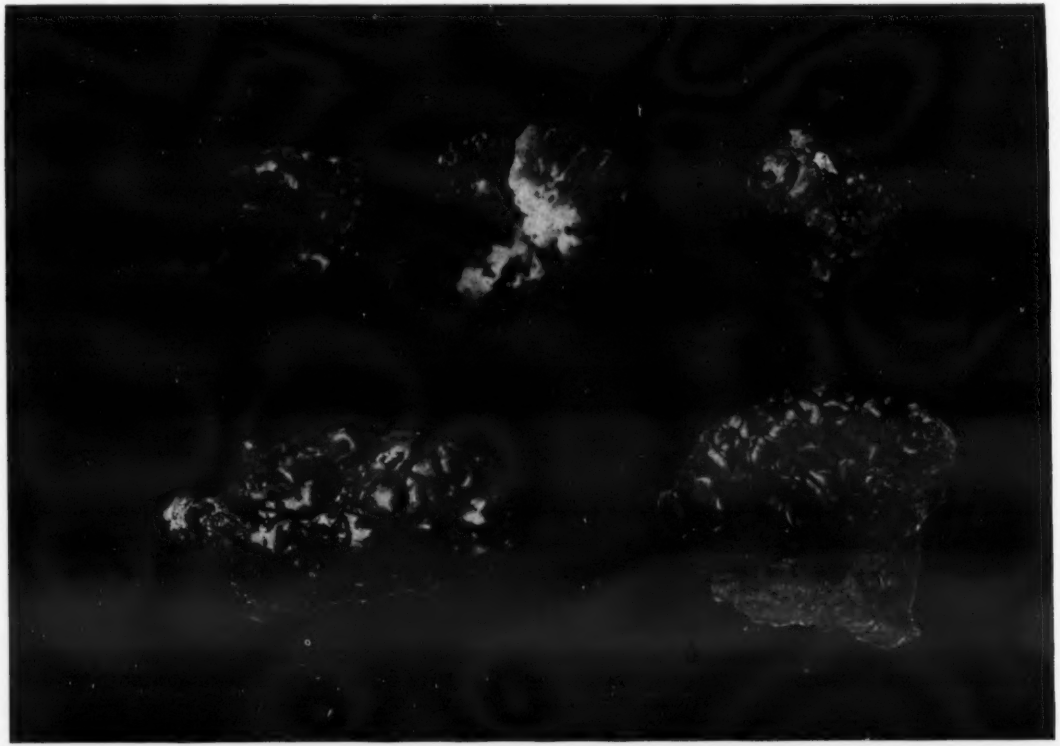
3965. On pine, January 17, 1920.

4074. On partly decorticated pine branch, February 4, 1920. Spores 5.5-7.4 x 17.4-23μ.

4132. On decorticated cedar pole in Arboretum, February 21, 1920.

Frequent on pine wood. Schweinitz.

PLATE 48



DACRYMYCES AURANTIUS. No. 3500.

2. **Dacrymyces aurantius** (Schw.) Farlow.

D. chrysospermus B. & C.

PLATES 23, 48 AND 63

Plants forming compact, rounded, brain-like, complicated masses, the surface grooved and folded through the compacting of the partly separated components; surface slimy when very wet. Color deep orange all over except where it fades into the white base which extends into the substratum as a kind of tough root. Flesh tough, sub-gelatinous, color of surface, translucent; tasteless and odorless.

Spores (of No. 3500) deep orange, curved-elliptic (sausage-shaped), smooth, 7-9-celled, the great majority 8-celled before sprouting, 5.5-7 x 18-22.5μ. Basidia slender, with two long forks.

The orange color becomes more red in the dried plants, and this character, together with the large size and the tough, white, radicating, usually flattened base, distinguishes this easily from related species except *Ditiola radicata*, which see for distinctions. It is common with us on corticated pine wood, the root extending through the bark and flattening against the wood.

Farlow's description of a plant he took to be *T. aurantia* Schw. agrees with ours. He finds the spores to be 5.5-7.5 x 20-25μ, four- to eight-celled (Appalachia **3**:248. 1883). Mr. Lloyd seems to have changed his opinion as to the species as he has seen my plants and agrees with my determination although he has illustrated something entirely different as this species (Myc. Notes Old Sp. Ser. N. 1:11. 1908). He thinks our plant does not grow in Europe.

I find in the Schweinitz Herbarium fortunately an adequate bit of this still in the original envelope, unmounted (on a mounted part the Dacrymyces has almost wholly disappeared). The spores are just like those of our plant and unlike those of any other. They are 6.2-7.4 x 18-21μ, mostly 8-celled. In the Curtis Herbarium is an even better collection from Schweinitz (Bethlehem) under the name *T. aurantia*. It is certainly like ours, with abundant spores which are large, 8-celled, curved, 6.2-7.2 x 16.5-23μ. That *D. chrysospermus* B. & C. is also the same is thought most probable by Dr. Farlow, and the plants distributed by Ravenel (No. 466) as *D. chrysospermus* are like *T. aurantia*. Under the name *D. chrysospermus* in the Curtis Herbarium is a collection

from Massachusetts (Sprague No. 778: Curtis No. 6211) which is like *T. aurantia* and like our plants. The spores are 8-celled, 6-7 x 18-20μ. The original description of *D. chrysospermus* is as follows (adapted): "Erect, clavate-lobed, orange; spores golden, 4-6 septate. On stumps, erect, lobed above, orange, dusted with the golden spores. More highly developed than *D. deliquescens*. New England. Sprague." (Grevillea 2:20. 1873). *Dacrymyces multiseptatus* Beck of Europe on pine seems near or the same. The spores are given as 7-10 septate, 20-26 x 6-7μ (see Sacc. Syl. 6:799). It is also of interest to note that Bresadola has referred to *D. palmata* (Schw.) Bres., a European plant on bark of *Abies excelsa*, that is represented in the New York Botanical Garden by a good collection from him. This cannot be distinguished from our *D. aurantius* except that the spores average shorter (5.5-6 x 13-18.5μ, with 8 cells). Brefeld's idea of *D. stillatus* seems much more like *D. aurantius* than like *D. abietinus* (see notes under latter species).

3500. On pine log with bark, north of Meeting of the Waters, October 22, 1919. Photo and painting.

3837. On pine log with bark, south of athletic field, December 7, 1919. Spores 6-7.4 x 14.8-24μ, eight-celled.

3917. On pine log with bark, Battle's Park, December 21, 1919. Spores 7-8 x 17-26μ, eight-celled.

3985. On pine bark from fallen limbs, southeast of old graded school, January 19, 1920.

4004. On dead pine limbs with bark, near outdoor stage, Battle's Park, January 22, 1920. Spores elliptic, 6.6-7.7 x 15-23μ, some divided when shed into eight cells.

4080. On pine bark, February 4, 1920. Spores bent-elliptic, 5.5-7.5 x 14.8-22μ, eight-celled.

4193. On pine bark, February 25, 1920. Spores 6.3-7.4 x 14.8-22.3μ.

3. **Dacrymyces involutus** Schw.

D. corticoides E. & E.

PLATES 23, 50 AND 63

Forming compound, adherent, rather thin, convoluted patches reaching a length of about 6 cm., a breadth of 2 cm. and a thickness of 2-4 mm., the component parts about 3-5 mm. broad and fused with adjoining ones, each attached in center by a distinct whitish, tough, little root about 3-5 mm. long, which tapers downward to a point and is buried in the soft wood; exposed surface of the pads

orange-yellow, more or less closely convoluted like a brain, not glaucous; this form varies to gregarious colonies of smaller plants as small as 1 mm., some crowded, some single. Young plants are mostly the same orange color as older ones, but others have a distinct tint of olive as in *D. minor*, also like the latter in the protection of the very young plants by a flocculent-cottony coat, which is broken through and at times carried up for a while as a little white cap; texture toughish waxy-gelatinous; surface opaque, inner part transparent and concolorous.

Spores (of No. 3972) orange-yellow, sausage-shaped, curved, 4.3-6.6 x 13-18.5μ, soon divided after shedding into four cells. Basidia as usual in the genus, strongly two-pronged, 3.7 x 4μ thick.

A striking plant, peculiar in the distinct little round roots which descend into the wood about 3-5 mm. apart, the effect being like that of a lot of thickish and irregular thumbtacks with the heads fused, and the points stuck in the pine. It differs from the other yellow or orange species as follows: from *D. abietinus* by rooting bases, stronger color, larger masses and shorter spores with fewer cells; from *D. aurantius* in smaller and, when in masses, separate rootlets which are not so deeply penetrating, in shorter spores, in not drying red, and in occurrence on decorticated and more rotten logs; from *D. Ellisii* in larger masses, spores averaging longer and in growing on pine; from *Ditiola radicata* in unbranched and proportionally smaller stalks, absence of viscidity, occurrence on decorticated wood and in not drying red; the spores are nearly alike.

We have examined the type of *D. involutus* Schw. in his herbarium and find that it agrees with our plant, showing the characteristic form and the flocculent covering in youth. The spores agree perfectly except that they are not quite so long, a matter of small importance as the length of spores in this genus varies considerably in different collections. In the Schweinitz collection they are elliptic, curved, about 4-celled, 5.5 x 12.5μ. Schweinitz's description is as follows:

"Of the size of *D. stillatus*, subrotund-dilated, gyrose-plicate, pale golden. Base covered with fibrous white tomentum which often grows over the whole fungus. Related to *D. lacrymalis*, on old wood at Salem and Bethlehem."

This is certainly *D. corticoides*, collections of that species determined by Ellis at the New York Botanical Garden, agreeing perfectly and the description agreeing in convincing details (Jour. Myc. 1:149. 1885). The "narrow, white, subbyssoid margin" appears clearly in our plants when drying undisturbed. The color of the dried plants is a dull reddish-brown with yellow areas;

partly dried plants are more orange than fresh ones. Lloyd has seen our plants and thinks them *Arrhytidia flava* Berk., which in a letter he says is "certainly co-generic and possibly the same as *D. corticoides.*" See also Myc. Notes **61**, fig. 1780. 1919. Patouillard also thinks the species should be referred to Arrhytidia as it is not truly gelatinous. This is also indicated by the fact that dried plants do not revive at all well when moistened again. For variety *conigena* E. & E. (spelled *canigena* in error) on pine cones see Jour. Myc. **2**:87. 1886. From the description it would seem than *D. confluens* Karst. might well be the same thing (Sacc. Syl. **6**:801). I have retained our plant for the present in Dacrymyces to avoid a multiplicity of closely related genera.

3972. On a decorticated, rotten pine log by path to Meeting of the Waters, January 17, 1920. Photo.
4079. On a decorticated pine log near Meeting of the Waters, February 4, 1920.
4179. On decorticated pine, February 26, 1920. Spores curved-elliptic, orange, four-celled, 5-7 x 11-14.8μ.

4. **Dacrymyces pedunculatus** (B. & C.)
Exidia pedunculata B. & C.

PLATES 23, 41 AND 62

Plants single or crowded and compounded into groups or rows up to 3 cm. long, simple individuals 2-3 mm. broad, 1.5-6 mm. thick, turbinate, rooted by a stout base, the flat top margined. Texture rather softly gelatinous, the stem tougher; color of raisins or a little paler; surface dull, minutely granular under a lens.

Spores (of No. 4158) very large, elliptic, 9.3-11 x 21-27μ, eight-celled soon after falling, orange with a tint of salmon, soon sprouting into small, elongated sporidia 1.7-2 x 3.5-4.5μ, which may be borne in groups. Basidia very large, 108-130μ long, 9-9.5μ thick.

The simple plants are shaped about like a short horseshoe nail and approach in form *D. involutus;* the flattish top may have a few wrinkles or be quite smooth. The root is about 2-4 mm. long and ends in a paler but not white mycelium which runs between the bark and wood. Compound groups are rooted by an elongated flat plate which gives rise to a crowded and convoluted group of heads much as in *D. aurantius.* The species is very distinct not only in the very large spores and basidia but also in the color, which is about that of *Exidia gelatinosa.* It is odd that the spores are so differently colored from

the plant, but several good prints make the color certain. It will be remembered that in *Tremella colorata* Peck states that the spores are of the same raisin color as the plant. There is fortunately in existence in the Curtis Herbarium a good collection of *Exidia pedunculata* B. & C. (Society Hill, S. C., No. 3750), which I find on examination is certainly this. They are on pine with same shape and color, thick spores unmistakably the same but averaging somewhat shorter than in our specimens. They are 8-celled, 7-10 x 16-22μ.

4158. On a fallen, corticated branch of *Pinus Taeda*, February 21, 1920.
4185. On a corticated pine branch, Strowd's lowgrounds, February 25, 1920. Photo. Spores 9.7-14 x 20.5-27μ.

5. **Dacrymyces Ellisii** n. sp.

PLATES 23, 50 AND 63

Plants bursting through the bark and forming small, flattish, smooth or crumpled pustules about 2-6 mm. wide which are sometimes crowded into somewhat larger masses up to 15 mm. wide; the pustules lie flat on the substratum but are the expanded tops of tough, whitish stalks which are hidden by the bark into the cracks of which they descend for several mm. and finally fade into the white mycelium; surface damp, somewhat viscid, firmly gelatinous, orange or wine-color, fading to pale or sordid yellowish.

Spores (of No. 3861) deep orange, smooth, sausage-shaped, bent, a part of them divided into about four cells when shed, 5-7 x 10.5-13.3μ.

The species is somewhat scarce in American herbaria and seems to have no settled name. It occurs in the Curtis Herbarium (Massachusetts, Sprague, bark of oak) under the name *D. deliquescens*, but it cannot be that species. Others so named in the same herbarium are different, one from Massachusetts seeming to be *D. abietinus*. I have tried to find out what *D. syringae* really is but have not succeeded. The Flora Danica figure (Pl. 1857, fig. 3) does not help much. *Dacrymyces syringicola* is different (see p. 171). Plants at the New York Botanical Garden on magnolia labelled *D. diplocarpus* E. & E., but apparently never published, have spores 3-septate, 4-5 x 11-13μ and seem the same as ours. They were sent by Ellis to Patouillard who said he did not know it. A similar collection by Ellis on magnolia bark is labelled *D. syringae*. Another collection on oak of the same thing from West Virginia (Nuttall) was sent to Massee who determ-

ined it as *Tremella enata* B. & C., which is certainly different if Curtis' No. 2456 can be said to represent it (see page 149). Lloyd has seen our plant and says: "This is not sure to me for it is too permanent and the spores of *deliquescens* are not orange but pale yellow." The species is certainly different from *D. minor* (*D. deliquescens*) which grows on decorticated wood, has much paler spores, and less orange and less complex fruit bodies without distinct roots and which become very inconspicuous when dry. It does not seem impossible that *Dacryopsis Ulicis* (Plour.) Sacc. may be our *D. Ellisii.* The appearance is much the same and the spores 4-celled, 5 x 15-18μ. (See note under *Dacryopsis ceracea*). From *D. abietinus* and *D. aurantius,* the other conspicuous yellow or orange forms, it differs in growing on deciduous wood and in the much shorter spores; from the latter it differs also in smaller size, but is like it in having a toughish, contracted, white rooting base.

3861. On branches of peach in a brush heap, December 9, 1919. Photo. Type.
3918. On decaying maple limb, December 21, 1919. Spores orange, smooth, sausage-shaped, some bent, 5.5-7.4 x 11-14μ. Spores sprouting on slide with from one to four sprouts, some three-septate.
3982. On decaying oak log, January 18, 1920. Spores bent-elliptic, 4.8-6 x 10.5-12μ, soon divided into four cells.
4003. On fallen oak limb, January 22, 1920.
4035. On decaying maple limb with bark, January 25, 1920. Spores sausage-shaped, 4.8-6.7 x 12-15μ, 4-celled before sprouting.
4036. On piece of decayed oak, January 25, 1920. Painting.
4120. On bark of decaying birch limb, February 14, 1920. Spores 4-5 x 12-14.8μ.
4170. On a corticated oak branch, February 23, 1920.

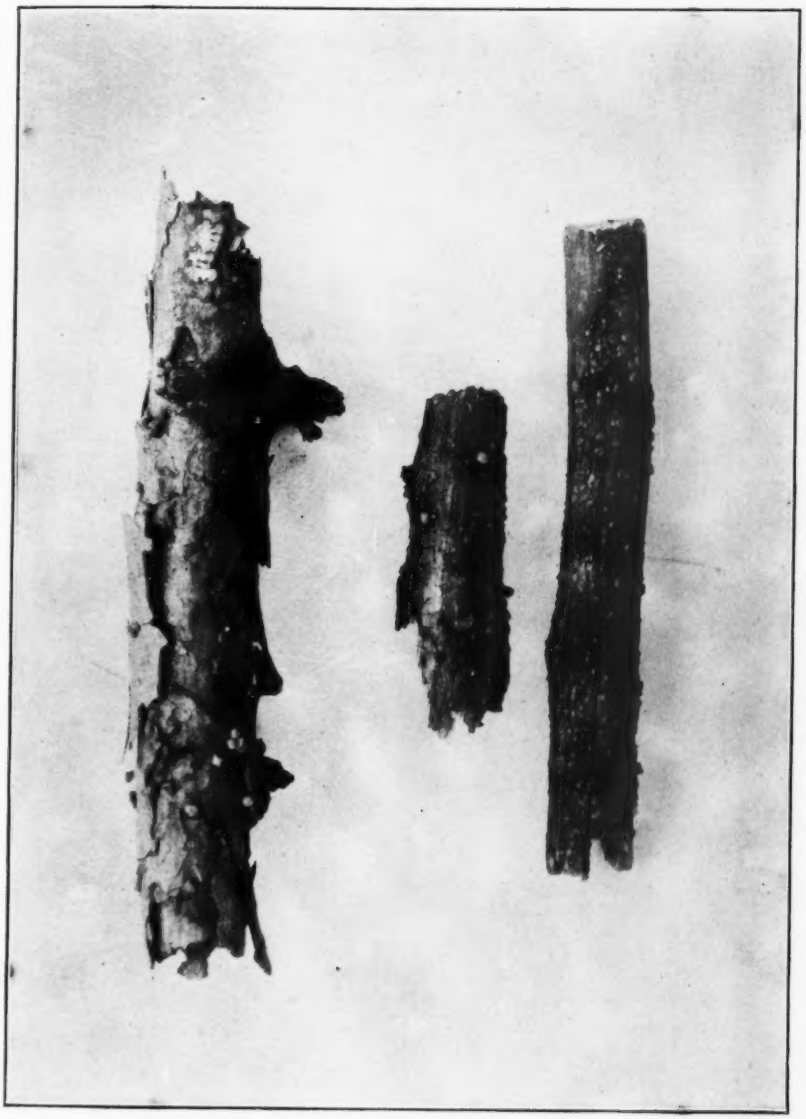
6. **Dacrymyces minor** Pk.

?D. deliquescens (Bull.) Fr.
?D. lacrymalis Pers.
?D. hyalinus Quelet

PLATES 49 AND 64

Plant forming very small subspherical pustules about 1-2 mm. in diameter, at times crowded into somewhat larger masses; the surface sparingly convoluted or even, a little viscid, not with an obvious root; color of most a dull, translucent, light amber or smoky amber and usually with a slight olive tint especially when young, some plants mixed with the others are a more conspicuous yellow-amber; texture rather firmly gelatinous.

PLATE 49



DITIOLA RADICATA. No. 4109 (right)
DACRYMYCES MINOR. No. 4105 (left).

Spores (of No. 3926) pale yellow, curved, divided into (mostly) four cells, 4-6.6 x 11.1-14.8μ. Basidia as usual.

In No. 3941 some of the plants were very young and when just bursting through were covered over by a white flocculent coat through which they burst at the top or at times carried up for a while as a little white cap-patch. This we have noticed elsewhere only in *D. involutus*. In No. 3926 the plants after reaching full size collapsed in at the top and looked a good deal like small Pezizas, a rupture occurred in the firmer outer part, the margins of which turned inward and downward, leaving a crater into the softer part within. This is a character assigned to *D. chrysocomus* and this is what usually passes for that species and which it may in fact be.

There is no doubt that this is Peck's species, the description and the type agreeing in all particulars. Peck gives the spores as 5 x 12.7-15.2μ (my measurements from part of type kindly sent by Dr. House are 3.8-4.5 x 10.5-13μ). They also seem to agree quite well with plants collected at Asheville by Beardslee and referred by Lloyd to *D. hyalinus* (Myc. Notes **58**:828. 1919). Beardslee writes me that his plants also grew on decorticated, deciduous wood. The species differs from *D. Ellisii* in smaller size, absence of an obvious root, different color (at least when dry), white coat when just appearing (?), and spore cells more swollen when sprouting. Dried plants of *D. minor* look like minute drops of brownish amber and are almost invisible without a lens, while those of *D. Ellisii* are reddish, larger, and more conspicuous. It is more than probable that this is the true *D. deliquescens*. Lloyd has seen our plants and refers them to that species, and from Bulliard's description and figure there is no reason to conclude that it grows on coniferous wood. The assumption is rather to the contrary as he warns against confusing it with droplets of sap found on certain deciduous trees mentioned. Fries considered his *D. tortus*, which grows on coniferous wood, the same as *D. deliquescens*, and there is much confusion in Europe in regard to the latter species, which is usually said to grow on coniferous or on both coniferous and deciduous wood. For example M. Patouillard who has had the kindness to give me his conception of *D. deliquescens* and to send me a good specimen from his herbarium, writes as follows: "Almost everybody indicates this species only on conifers. But one meets it also on every sort of rotten wood." On examination we find this specimen to agree in all essentials with our *D. minor*. Bresadola is

also of the opinion that it grows on both kinds of wood, and notes its occurrence on *Quercus*, *Carpinus*, and *Pinus sylvestris* (Ann. Myc. 1:115. 1903.) Brefeld (l.c. p. 141) describes *D. deliquescens* carefully, and there are no serious discrepancies between his plants and our *D. minor*. He gives the spores as faintly yellow, 5 x 15; the plants growing on deciduous wood and seated directly on the wood, not on bark. Bresadola gives the spores of *D. deliquescens* as 12-15 x 5-6μ. It seems even less doubtful that *Tremella lacrymalis* Pers. is not different from *D. minor*. Persoon's figure (Icon. Fung. Pl. 10, fig. 3, 1803) looks about right, the plants growing on deciduous wood, the largest one about 4 mm. broad. He describes it as rounded to somewhat irregular, pezizoid, small, pellucid, yellow. Occasional on putrescent wood. He refers to Bulliard's *Tremella deliquescens* as related (Syn. Fung. p. 628. 1801). Brefeld describes a new species *D. lutescens* very near *D. deliquescens* but differing in the absence of fruiting bodies which bear gemmae, in the clear orange color, and the larger spores, 10 x 28μ. *Dacrymyces cerebriformis* Bref. is somewhat similar to the two preceding, but is smaller, prefers birch, and has 4-celled spores more curved than the other two, 8 x 25-28μ. There are still two other little species described by Brefeld, one *D. longisporus*, scarcely larger than a pin head, found on old fences; it is pale, yellow, spores 12- to 15-celled, 15 x 35-40μ; the other, *D. ovisporus*, a remarkable form with oval spores, 15 x 20-25μ, which are divided into many cells by walls in all directions. Otherwise the species, he says, cannot be distinguished from the preceding and occurs with it.

3926. On an old oak chip, December 22, 1919.

3941. On twig of deciduous tree, December 22, 1919.

3945. On *Ligustrum chinense* in Arboretum, January 16, 1920. Many of the young cushions have an olive tint added to the amber. Spores about 4.8 x 12.5, not divided into cells when first shed.

4012. On a fallen branch of osage orange (Maclura), January 23, 1920. Spores creamy yellow, curved, 4-5 x 10-13, mostly divided into four cells which soon sprout, forming either small sporidia or mycelial threads.

4105. On a decorticated branch of osage orange, February 13, 1920. Spores 3.7-5 x 10-12.5. Photo.

4165. On corticated dogwood branch, February 23, 1920. Growing mostly in lines across the twigs through circumcissile cracks in the bark. Washed out to almost hyaline. Spores 6-7.4 x 13-15.5, 4-celled.

4166. On decorticated oak branches, February 23, 1920.

4181. On decorticated sycamore wood, February 26, 1920. Spores 3.7-5 x 9.3-11.2, 4-celled.

4200. On crepe myrtle, March 5, 1920.

7. Dacrymyces pallidus n. sp.

PLATE 61

Bursting through cracks in the bark of pine and forming elongated, irregular, pulvinate, convoluted patches up to 1.5 cm. long, 2.5-4 mm. broad and 2-3 mm. high. Texture firmly gelatinous. Color varying from nearly hyaline (a very pale, watery amber) to a pallid amber-clay or faint smoky amber. The patches are attached by a flattened root which passes through the bark and spreads out a little on the wood, but does not enter it.

Spores (of No. 4072) 4-4.5 x 10-13μ long, occasionally septate with one cross wall.

This is quite different from any of the other species. It is the palest. The absence of orange color and the shorter spores separate it easily from *D. aurantius* and *D. involutus*, the shorter spores and different form from *D. abietinus*, the absence of orange color and growth on pine from *D. Ellisii* and the quite different form, larger size, distinct root and growth on pine from *D. minor*. There is no exposed stalk.

4072. On a pine branch with bark on, February 4, 1920. Photo and drawings. Type.

4162. On corticated fallen pine branch, February 22, 1920.

8. **Dacrymyces fuscominus** n. sp.

PLATE 63

Minute, flattish, convoluted clusters up to 5 mm. long and 1-2 mm. wide, less than 1 mm. thick; color sordid smoky, with clay tints in places, almost the color of the bark, very firmly gelatinous, almost waxy, the fibers closely packed and not separated by jelly.

Spores elongated, a little bent, 3.5 x 8.5-10.5μ. Basidia forked.

This is nearest *D. pallidus* which differs in larger size, lighter color, less hard consistency and slightly longer spores, also in growth on pine. The very firm texture of the plant distinguishes it from all other species of Dacrymyces and it would perhaps be better to refer it to the genus *Ceracea* except that the few described species of that genus form very thin, completely effused plates which are not convoluted, having the habit of a Sebacina, a waxy consistency, and the basidia of a Dacrymyces. *Ceracea vernicosa* Cragin, found in Kansas, covers with a thin coat undeveloped plants of a Polyporus (see Am. Myc. 1:58. 1885). *Ceracea Lagerheimii* Pat. grows on wood in the

eastern tropics, is ochraceous, waxy, resupinate, 2-5 cm. long; basidia 5 x 40-60μ; spores 5 x 10-12μ, with one septum in the center (Bull. Soc. Myc. de Fr. 9:141, Pl. 8, fig. 5. 1893). In the Curtis Herbarium is a collection from Schweinitz (Bethlehem on Acer) labelled *D. virescens* Fr., which looks a good deal like our No. 4075. His plants are very small, pulvinate, much convoluted, blackish when dry, sordid, smoky ochraceous when wet; texture waxy or dense. I could get no spores from the plants and no distinct basidia.

4075. On oak bark, back of Athletic Field, February 4, 1920. Type.

We include the following notes for the convenience of students:

Dacrymyces syringicola B. & C. A collection from Society Hill, S. C., labelled *D. Syringae* Fr., in the Curtis Herbarium, bursting through the bark of dead lilac twigs, is not a Dacrymyces, but is made up at least superficially of large more or less rectangular bodies resembling parenchymatous cells. A collection of the same thing from Santee Canal, S. C. (Ravenel), is labeled *D. destructor* B. & Rav. It was found on a dying pear branch. This last is supposed to be the same as *D. syringicola* B. & C. by Massee.

Dacrymyces violaceus Fr. is reported by Schweinitz from North Carolina on apple wood. There is a bit of decorticated apple branch under this name in the Curtis Herbarium, but there is apparently nothing left on it of value. Fries described the species as "small, compact, subcompressed, gyrose, violaceous, on trunks of pears" (Epicrisis, p. 592).

Dacrymyces chrysocomus (Bull) Fr. is represented in the New York Botanical Garden by a good collection from Bresadola on corticated pine twigs. The plants are small, amber-colored, collapsed to a membrane; spores thick, divided into about eight cells, 9.3-12 x 18-21μ. Brefeld gives the spores of the species as up to twenty-celled, 15 x 35μ. We have not found anything like this.

Dacrymyces conglobatus Pk. (Rep. 32: 37. 1879) is evidently not a Dacrymyces. He also reports *D. fragiformis.*

Dacrymyces fragiformis (Pers.) Nees. There is evident confusion here. In the original description Persoon says: "Subcompact, rounded, red, folds crowded, somewhat lobed. When dry 4-6 lines broad, otherwise as large as an inch across, color fading, internally pale. On bark of pine" (Syn. Fung. p. 622. 1801). His fig. 1, Pl. 10, in Icon. Piet. shows the plants crowded, of good size, reddish outside, white within. Quelét gives the spores as 40-60μ long, triseptate (Fl. Myc. Fr. p. 17. 1888). Herter gives the spores as 20 x 7μ, many septate, and says the species is doubtful (Krypt. Fl. Mark B. 6:56. 1910). See also Rabenhorst's Kript. Fl. 1:277. 1884. Albertine and Schweinitz introduced confusion by assigning to this species a form β *carpinea*, an entirely different plant that grows (apparently parasitically) on the fruiting body of the black, encrusting Ascomycete *Diatrype stigma* (formerly Sphaeria or Hypoxylon) on twigs of frondose wood. Schweinitz reports this as *T. fragiformis,*

not as the variety, in both Syn. Car. (No. 1147) and Syn. Am. Bor. (No. 1121). We have this little plant in plenty at Chapel Hill and find it in no way related to this group of fungi, the only resemblance being the subgelatinous texture and external form. The plants are very small, deep red, scarcely as large as a clover seed, scattered or approximated. *Dacrymyces macrosporus* B. & Br. is apparently the same. No one seems to know what the original *T. fragiformis* of Persoon is.

The following are translations of Schweinitz's original descriptions of species of Dacrymyces:

Dacrymyces pellucidus Schw. (No. 1129. Syn. Fung. Amer. Bor. p. 186: 1832): "Large, extending 3 inches in length and breadth, white, subpellucid, in the growing state, resembling the early stage of a gelatinous Hydnum; the form is also gyrose like a Tremella, variously lobed, with thick blunt lobes. The internal structure is entirely that of a Dacrymyces. In the dry state it presents a hard thick membrane, plicate-veined, pellucid. Large, rather rare on wood at Salem; also seen near Philadelphia." A good plant in the Schweinitz Herbarium shows this to be a Tremella or Exidia with 4-celled basidia about 9.3μ thick. It is probably *T. fuciformis*.

Dacrymyces capitatus Schw. No. 1130. Syn. Fung. Amer. Bor. p. 186): "Stipitate, penetrating the stem (of Brassica) with its stalk, base tomentose, thick, scurfy (resembling a Ditiola), ending in a globose head, often compressed, sometimes plicate, reddish golden in color. It grows scatteringly. Internal structure exactly that of this genus. Seen on the stem of Brassica, Bethlehem." Possibly a true Dacrymyces, but a slide shows no spores nor developed basidia.

Dacrymyces difformis Schw. (No. 1130. Syn. Fung. Amer. Bor. p. 186): "Multiform, variously contorted, bursting from the epidermis almost like a Myxotrichus, reddish golden, subexpanded. Internal structure as in the others. Rare on the twigs of rose clusters, Bethlehem." A collection from Philadelphia by Schweinitz shows a few small plants on a rose branch about one centimeter thick. A slide shows nothing decisive.

Dacrymyces epiphyllus Schw. (1132. Syn. Fung. Amer. Bor. p. 186): "It immediately recalls a Sclerotium, but afterward slowly shows the internal Dacrymyces structure. Gregarious, subrotund or oblong, yellowish, minute, one-half line broad, sub-pulvinate, as if inherent, often subconfluent. Seen on the leaves of Galium at Salem." A good collection in Philadelphia shows no evidence of being a Dacrymyces. It scarcely swells when wet, and the internal structure is unlike this genus.

Dacrymyces viticola Schw. (No. 1133. Syn. Fung. Amer. Bor. p. 186): "Two-formed. Bursting forth from the cortex or epidermis, provided with a thick stalk, base obscured or covered with tomentum, expanded above into a reddish-orange gyrose head. Also on decorticated wood, effused, gyrose-plicate, thin, of the same color. Each form preserves the internal structure of a Dacrymyces. Rare, bursting forth from the epidermis of dead grape, Bethlehem." In Philadelphia both forms are represented. A slide of the second form

shows basidia and spores of the Dacrymyces type, the latter, few in number, about 4.4 x 11μ, apparently 4-celled. (Lloyd says there is a specimen of this at Kew.)

Dacrymyces azaleae Schw. (No. 1134. Syn. Fung. Amer. Bor. p. 186): "Scattered, minute, bursting from the bark as a Myxosporium, yellowish-golden, pellucid, expanded into a subpalmately-lobed head, short. Internal structure as above. Rare on dead branches of *Azalea nudiflora*. Bethlehem." The type in Philadelphia shows minute globules, barely visible without a lens, reddish, scattered, pale and toughly gelatinous when wet and seen to be compounded. Probably a true species. A preparation has the general appearance of Dacrymyces, but no spores nor good basidia were found.

Dacrymyces cinnabarinus Schw. (No. 1127. Syn. Fung. Amer. Bor. p: 186): "Small, erumpent, attached closely to the epidermis, at first convex, at length concave and subpezizoid, color brilliant cinnamon, often confluent, and covering the branches with large colonies, longitudinally effused. It is easily shaken off, separating from the substratum. When soaked in water the interior appears distinctly floccose. Frequent on Willow branches, Bethlehem." We have examined the type and find it to be a typical Ascomycete, with plentiful asci containing eight spores.

DACRYOMITRA

Plant stalked, the stalk smooth, gelatinous, enlarged above into a more or less flattened, convoluted, viscid head, which is more or less bent over and is covered by the gelatinous hymenium. Spores elongated, orange, divided into four cells before sprouting. Basidia as in Dacrymyces. Distinguished from Ditiola by the larger size, different shape and the larger, four-celled spores; from Dacryopsis by the large size, more convoluted head, more gelatinous texture and larger spores. We have but one species.

Dacryomitra dubia Lloyd

?Dacryomytra glossoides (Pers.) Bref.

?Dacrymyces flabellus Ellis

PLATES 23 AND 64

Plant 12 mm. high, the stalk 9 mm. long and 3.5 mm. thick, orange-yellow, smooth, gelatinous; the cap irregular, flattened, and bent over, 6.5 mm. broad, 3 mm. thick, convoluted, orange, gelatinous.

Spores large, orange, resembling those of Dacrymyces, 6.3-8.1 x 13.3-17μ, rarely up to 20μ, average 7 x 16μ, divided into four cells before sprouting. Basidia slender and two-forked, about 4.4μ thick.

PLATE 50

FIG. 1. DACRYOPSIS CERACEA. No. 4121.
FIG. 2 & 3. DITIOLA RADICATA. No. 4183.
FIG. 4. DACRYMYCES ELLISII. No. 4170.
FIGS. 5 & 6 DACRYMYCES INVOLUTUS. No. 3972.

The plant is distinctly viscid when wet. The stalk sits flat on the wood to which it is attached by a flat, tough, whitish plate which enters the wood vertically. Quite young plants are filiform at first, the head not apparent.

This agrees perfectly with *D. dubia* as figured and described by Lloyd (Myc. Notes **52**:742, fig. 1114. 1917). Lloyd does not state on what kind of wood his plant grows, but the European *D. glossoides* is said to grow on beech. This is apparently the only serious discrepancy in the habit or structure of that species and ours. Our plant is much more gelatinous than *Dacryopsis nuda.*

3969. On a pine log, woods back of athletic field, January 17, 1920. Painting.

DACRYOPSIS

Plant stalked and rooted, the stalk short, smooth or granular, subcartilaginous, capped above by a rounded or horizontally flattened, smooth or only slightly convoluted, viscid, toughly gelatinous head. Often compounded by branching of the root or stalk. Spores elongated, divided into two or four cells before sprouting. Basidia as in Dacrymyces. We have but one species (but see note under *Ditiola radicata*). For *D. gyrocephala* (B. & C.) Massee, from South Carolina, and for other species of Dacryopsis see Jour. Myc. **6**:181. 1890.

Dacryopsis ceracea n. sp.

PLATES 50 AND 65

Plant 4-6 mm. high, mostly compound from a flattened, tough, whitish rooting base, branched at once into a few stout stems which expand and crimp above where they are capped and covered by a glabrous, shining hymenium, which is deep wax-yellow and descends irregularly from the tip only about 2 mm. at most. Stem finely granular, dull, distinctly demarked from the hymenium and a little paler. Spread of the largest clump in our collection 1.3 x 1.9 cm.; a few simple plants stand alone with the unbranched stems capped with the smooth hymenium. Tips thick, bluntly rounded, about 1.5 mm. thick. Texture gelatinous, elastic, subtranslucent, the rooting base tougher. The base penetrates cracks in the bark and flattens out on the wood below. The hymenium is scarcely more convoluted than is necessary to follow the wavy apex it is situated on. In a few of the broader tips the hymenium is depressed and a little convoluted in the center. The plant has the habit of *Sparassis Herbstii* on a minute scale.

Spores (of No. 4121, print) smooth, wax-colored, slightly bent-elliptic, divided into two cells before sprouting, 3.7-4.4 x 7.4-10μ. The spores sprout by short sterigmata which bear single subspherical sporidia. Basidia divided into two prongs, slender, 3.4-4μ thick.

This seems certainly Dacryopsis, and of the described species only *D. Ulicis* (Plowr.) Sacc. is at all near in color, but that has spores 4-celled, 5 x 15-18μ and is otherwise different (Trans. Brit. Myc. Soc., 1:55, Pl. 2, figs. 2-6. 1898). *Dacryopsis Ellisiana* Mass. (*Coryne Ellisii* Berk.) was described from New York on decaying basswood log. According to Cooke it has spores continuous, 4-4.5 x 15μ (Grevillea 20:24. 1891).

4121. On piece of decaying oak limb, New Hope Creek, February 14, 1920. Type.

GUEPINIA

Small, tough, semi-gelatinous, upright, stalked, the stalk tomentose or scabrous, enlarged above where it is flattened or branched or lobed or wrinkled; hymenial surface confined to one side, limited below, i.e., the stalk not covered by it; basidia forked above into two long prongs; spores smooth, elongated, curved (sausage-shaped), orange or yellow, divided into two or more cells before sprouting; dorsal surface said to bear chains of conidia. Distinguished from Calocera by the broadened or thickened upper part with basidia on one side only, by the slippery but not viscid surface, and by the tomentose stem.

KEY TO THE SPECIES

Growing on deciduous wood, stem and sterile surface deep rich brown; hymenium not orange.....*G. elegans* (1)
Growing on deciduous and coniferous wood; hymenium orange when fresh.....*G. spathularia* (2)

Guepinia elegans B. & C.

It is rather surprising that we have not yet found this in Chapel Hill as it occurs both north and south of us and is reported by Curtis from this state. The following description is made from dried plants in the Curtis Herbarium (from South Carolina and Alabama) and the New York Botanical Garden Herbarium:

Plants cespitose or single, up to 2 cm. high, the distinct stalk terete, 5-8 mm. long, deep reddish brown, finely squarrose-tomentose, expanding above rather abruptly into funnel-shaped or fan-shaped

cap up to 1-2 cm. broad, the outside or sterile side continuing the surface and color of the stalk, the inner or fertile face smooth, glabrous and very dark blackish-brown (when dry). Basidia with two long prongs each about 3.8μ thick at base. Spores elliptic, somewhat bent, four-celled, 4.5-6.3 x 11.5-16μ. The plant is very different from *G. spathularia* and is easily distinguished by it colors and spores. It is known from New York to Brazil, and in the United States is, in the opinion of Lloyd, probably confined to elm. Lloyd also thinks that it is the same as *G. biformis* Pk., *G. bicolor* Pk. and *G. jurulensis* Hennings. See Myc. Notes **58**:825, fig. 1378. 1919.

Low and upper districts on trunks and logs. Curtis.

Guepinia spathularia (Schw.) Fr.

PLATES 23, 51 AND 64

This is a small, upright, spathulate plant with a distinct stalk which is simple or more or less branched and furrowed; growing in lines and clusters from dead, deciduous wood; height about 0.5-2 cm.; width about 2-5 mm. at the flattened spathulate or petal-like tip; stalk distinct, up to 1.5 cm. long, flattened above, rounded below, running through cracks in the bark down to the wood, base scurfy tomentose, the tomentum becoming finer upward and extending onto the sterile side of the expanded cap as a very fine pulverulence. Hymenium orange-yellow, rugose wrinkled longitudinally like a Cantharellus, confined to one side of the flattened upper part and distinctly delimited from the stem; sterile surface as deeply colored as the hymenium when damp, but becoming a light yellow or cream color when dry, the hymenium remaining orange; stalk brownish-yellow above, darker brown below; texture of entire plant tough, firm, subgelatinous.

Spores (of No. 3892) smooth, orange-yellow, elliptic, curved, 3.8-4.5 x 7.4-9.5μ, sprouting to form small, spherical conidia on short stalks, dividing into two cells before sprouting. Basidia long and deeply bipartite.

Not rare on logs and crossties of deciduous wood and on pine and cedar. On long soaking or exposure to rain the plants become faded to a pale amber or straw color. The size and form of this species are very variable. We have some on pine and cedar that are simply swollen above into a kind of rugose club with one side sterile (see Pl. 23, fig. 14) and from this form there are variations up to an ex-

panded, petal-like form with strongly crimped margins. A good many species have been described in this genus, most of which are certainly without validity. I am including in this species both the form on deciduous and that on coniferous wood, but I am not at all sure that they are the same. However, as the basidia and spores cannot be distinguished and there are a number of forms on both kinds of wood, I have not separated them.

1073. On an oak log near Howell's spring, October 18, 1911. Drawings.
3377. Dead branch of oak, June 28, 1919. Spores 3.7-4.8 x 8.5-11μ. Photo and painting.
3852. On pine pole on basketball court of old graded school, December 9, 1919. Spores smooth, orange-yellow, elliptic or curved, 3.7-5 x 9-11.1μ.
3892. On decaying wood of deciduous tree in Stroud's lowgrounds, December 13, 1919.
3913. On cedar posts at The Rocks, December 16, 1919.
3984. On oak wood back of athletic field, January 17, 1920.
3998. On a pine rail on a grape arbor, January 22, 1920.
4008. On cedar poles, arbor at the Rocks, January 23, 1920. Spores 3.8-6 x 7.7-10.5μ, a few longer; divided into two cells before sprouting.
Blowing Rock. Atkinson.
Common on pine wood. Curtis.

DITIOLA

Plants small, centrally stalked or seated by a point, enlarged above with the hymenium over the enlarged part; at times like a small Peziza, with the flat upper surface covered by the hymenium; not tomentose. Flesh toughish-fleshy, only the hymenium gelatinous. Spores elliptic, two- or four-celled before sprouting. Basidia as in Dacrymyces, etc. Distinguished from Guepinia by the smooth stalk (if present) and hymenium not lateral. We have found only two species.

KEY TO THE SPECIES

Growing on pine, bursting through bark, color orange yellow ..... *D. radicata* (1)
Growing on deciduous wood; about clay color; very small ..... *D. albizziae* (2)

1. **Ditiola radicata** (Alb. & Schw.) Fr.

PLATES 49, 50 AND 63

Plants gregarious or crowded into lines or masses up to 1.1 cm. long, 1-5 mm. high, abruptly expanded at top into a horizontally flattened, irregular, dull, orange-yellow head, bearing the hymenium,

PLATE 51

GUEPINIA SPATHULARIA. No. 3377

which is about 1.5-3 mm. broad, often depressed by a central wrinkle with the margin a little lobed or at times deeply constricted to form a compound head or two separate heads, or further compounded and crowded by branching of the stem below; the exposed stalk short, only up to 1 mm. long and 1-1.5 mm. thick, unless compounded, not visible plainly except in youth, usually flattened, descending through the bark by a flattened, whitish root about 2-3 mm. long, tough and hardly subgelatinous. Texture of cap firm and toughly gelatinous, softer on exposure in age.

Spores (of No. 4183) bent-elliptic, 4-celled before sprouting, 5-6.6 x 11-16.6μ; basidia slender, two-forked.

The head is distinctly viscid when wet, and when young is covered with an inconspicuous, subhyaline, outer coat which softens in water and seems to be washed off in particles. After disappearing from the top a remnant of it may be seen when soaked as a little area of fringe around the margin of the head. The stalk penetrates holes and cracks in the bark as a root and disappears into more or less obvious plates of mycelium. The root is often branched from the base or further up to form a compound row or group. It is usually glabrous on exposed part, and where protected by bark it is whitened and somewhat fibrous with mycelium. The smaller or younger plants have very little, if any, free stem above the bark. As parts of the bark are easily removed in handling, one might be misled as to what part of the stem-root was exposed. On drying the plant shrinks, but retains its form unless old and softened; the color of the cap becomes a translucent red, with the exposed stalk about the same color or more brown, while the rooting part remains whitish. Old plants exposed to rain lose much of their color and dry pale and membranous.

Our plant is most like *Dacrymyces aurantius*, but differs from it in the less ample and less plate-like root, viscid head, and shorter spores with only four cells. Large and mature plants cannot be distinguished with certainty from it without reference to the spore characters.

Lloyd has seen my plants, and I am following him in calling this *Ditiola radicata*, as he has collected that species in Sweden and should know it. There are discrepancies between our plants and the descriptions of this species. For example, Fries says it is covered with a flocculent white coat when young, and the spores are given by Hennings as two-celled, 3.8-4 x 8-10μ. Plants in the Curtis Herbarium

from Fries labelled *D. radicata* are not like my plants, but more like small specimens of my *Dacryopsis ceracea*. Spores, if present, are collapsed and shapeless. Plants in the same herbarium from Society Hill, S. C., on pine labelled *Ditiola gambosa* B. & C. looks just like our collections, but no spores could be found. It is also to be noted that collections from Europe in New York Botanical Garden Herbarium are on old, decorticated, weathered wood, and seem different from ours.

This agrees well with Massee's description of *Dacryopsis nuda* (Jour. Myc. **6**:182. 1891), and looks exactly like the figures of a plant collected by Beardslee at Asheville and referred by Lloyd to *D. nuda* (Myc. Notes **57**:841, figs. 1406-1408. 1919). According to Hennings's description also our plant agrees better with *D. nuda*. He gives spores of the latter as 4-celled, 5 x 14μ.

3968. On corticated pine wood, back of Athletic Field, January 17, 1920. Spores not septate when shed, 6.3-7.4 x 16.3-20μ.
4025. On decayed cedar limb, January 24, 1920. Spores curved-elliptic, some 4-celled, 6-7.4 x 12.9-16.6μ.
4109. On a fallen corticated pine branch, February 13, 1920. Photo.
4155. On corticated pine branch, February 21, 1920. Spores orange, curved-elliptic, 4-celled, 6-7.5 x 12.2-17μ.
4175. On corticated pine branch, February 21, 1920, Spores 5.5-6.5 x 11.3-18.5μ.
4180. On corticated pine limb, February 26, 1920. Spores 5.5-7 x 11-17μ, 4-celled.
4183. On corticated pine, February 25, 1920.
4192. On corticated pine limb. February 26, 1920.

2. **Ditiola albizziae** n. sp.

PLATE 64

Very small, centrally attached by a point, scarcely stalked, spreading out like a Peziza with the top flat, pale dull yellow (about clay color), hardly 1.5 mm. broad at top and less than 1 mm. high. Texture of cup waxy, toughish, the hymenium gelatinous; not reviving well when moistened.

Spores elliptic, two-celled, 4.5 x 8.5-9.5μ. Basidia slender, two-forked. See drawing.

This cannot be *D. sulcata* Schw., as a specimen from his herbarium (New England, Torrey) now in Curtis Herbarium has long, allantoid spores, 7.5 x 34μ long.

3996. On a dead branch of *Albizzia Julibrissin* (Mimosa) in Arboretum, January 21, 1920. Type.

CALOCERA

Plants growing on wood, upright, more or less terete throughout, simple or often branched, small, rarely up to 6 cm. high, often in rows from cracks; firm, tough, pliable, viscid, subgelatinous when very wet, orange or yellow, the hymenium covering all the plant except the whitish base (amphigenous). Basidia terete, elongated, forked into two long prongs each of which bears a spore; spores smooth, yellowish, sausage-shaped, divided into two cells before sprouting.

The hymenium is much denser than the inner flesh and is composed of densely fascicled groups of horizontal basidia which do not mature simultaneously. The plants resemble the Clavarias in form and are separated from them by their tough and more gelatinous structure, viscid surface and long-forked basidia.

KEY TO THE SPECIES

Growing on pine, gold or orange color, up to 6 cm. high..*C. viscosa* (1)
Growing on pine, yellow, minute, only up to 2 mm. high..*C. cornea* var. *minima* (3)
Growing on deciduous woods.....*C. cornea* (2)

1. **Calocera viscosa** (Pers.) Fr.

This plant has the form of a Clavaria, about 2-6 cm. high, slender, stalked, several times branched, the tips acute; color deep golden yellow or orange yellow, orange when dry, surface very viscid; texture tough and pliable, the base extending into a slender whitish root.

Spores oblong, curved, smooth, probably light yellow, about 4.5 x 9-11μ, divided into two cells before sprouting.

Not rare on pine stumps and usually in rows from cracks. We have seen it at Chapel Hill, but failed to make notes. The above description is therefore compiled from others. Distinguished from *C. cornea* by growth on pine, larger size and deeper color.

For good illustrations in color see Gillet, Pl. 85 (118), fig. 1; and Massee: British Fungi and Lichens. Pl. 27, fig. 8.

2. **Calocera cornea** (Batsch.) Fr.

PLATE 65

Cespitose and often fused at base, forming clumps or extended rows from cracks in the bark, about 5-15 mm. high, cylindrical, pointed at the tips, simple or a few times branched or pronged like an antler

above; viscid; color ochraceous yellow, or when very wet and swollen a paler soaked yellow; texture tough, subgelatinous when very wet.

Spores (of No. 3834) creamy yellow, smooth, bent, 3.8-4.8 x 9.3-11.1μ.

The plants are horny and reddish when dry or blackish when old. The base is subtomentose from the mycelium. The color of the fresh plants is removable by soaking in water overnight. The water becomes yellow and the plants when taken out dry whitish. With us the species is not rare on deciduous wood. See Gillet, Pl. 85 (118), fig. 2. *Calocera palmata* is probably the same. See Myc. Notes **62**: figs. 1656 and 1657 (as *C. palmata*) and fig. 1658 (as *C. cornea*). 1920.

A very delicate plant on pines and cedar that we find here may be a different species, but the spores and basidia are the same as in the above. Lloyd thinks it only a form. As extensive colonies run all about the same size and never cespitose, I have decided to treat it as a variety of *C. cornea*, as below.

3824. On fallen branches of Liriodendron, December 5, 1919. Spores creamy-yellow, smooth, mostly bent-elliptic, 3.7-4.8 x 7.4-10μ.

3834. On rotting oak limb, woods east of cemetery, December 7, 1919.

3. **Calocera cornea** var. **minima** n. var.

PLATE 65

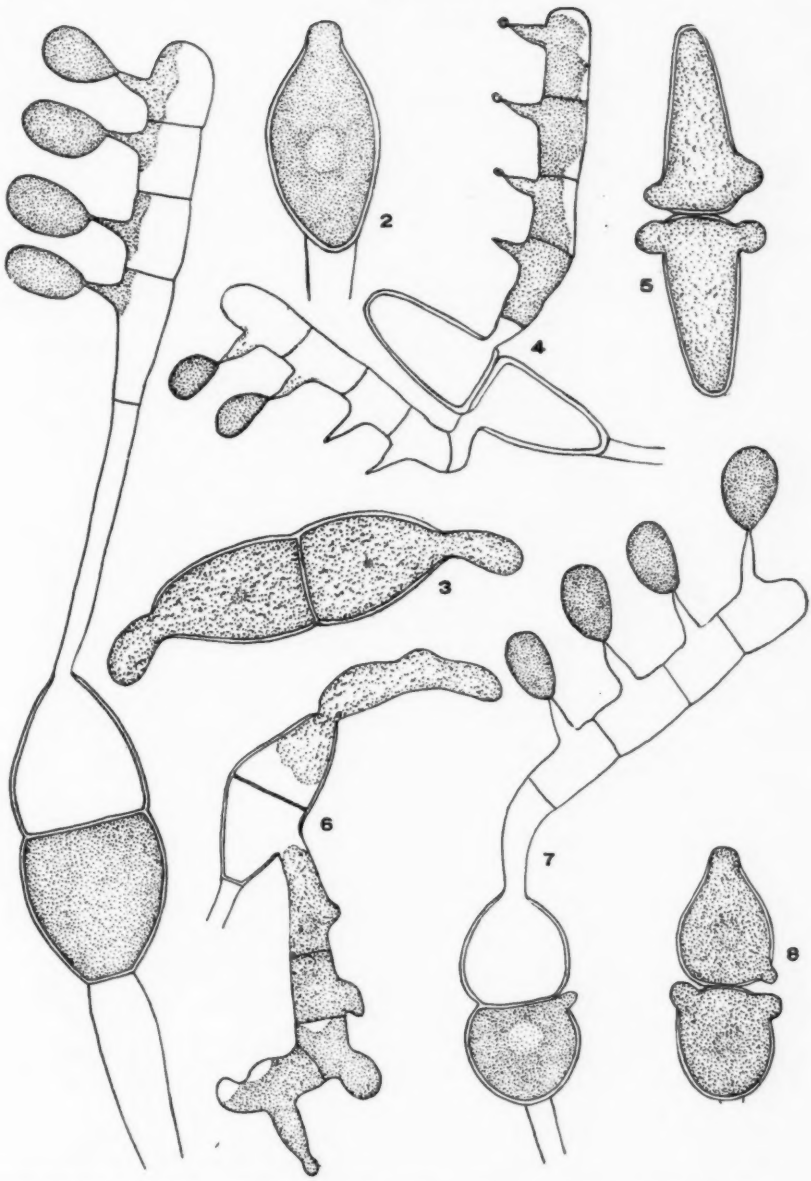
Minute, 1.5-2 mm. high, slender, densely gregarious, but not cespitose, simple or a few forked near apex or at any point, very rarely one branched into several prongs; stalk pale yellow or whitish, flatly and broadly attached, round, smooth, several times longer than the yellow, slightly enlarged, pointed, hymenium-bearing apex which looks not unlike that of *Mutinus caninus* in shape. This head may be a little rough or even knobbed or forked. Texture tough, subcartilaginous; surface viscid. Base pentrating the wood by a distinct root.

Spores (of No. 4088) elliptic, a little bent, yellowish under the microscope, two-celled a few days after falling, 3.8-5.5 x 7.4-11μ. Basidia forked, about 3μ thick.

4088. On a decorticated pine branch, February 4, 1920. Drawings.

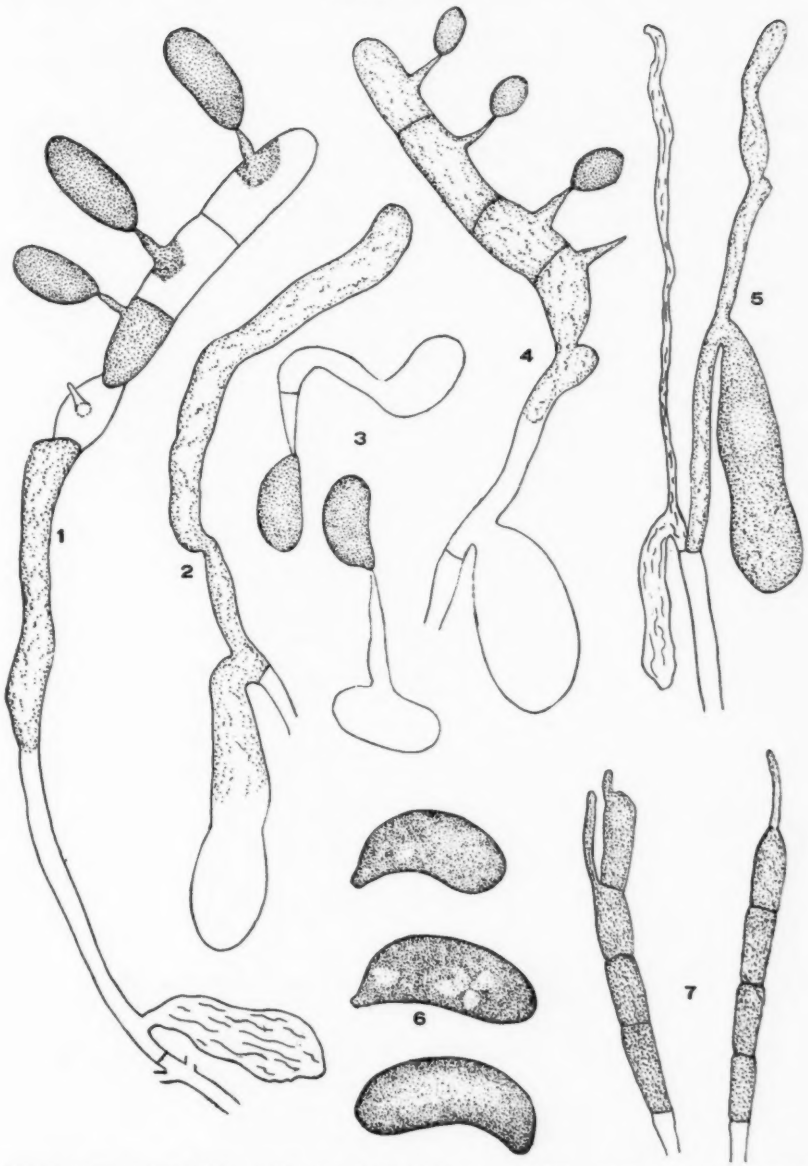
CHAPEL HILL, N. C.

PLATE 52



GYMNOSPORANGIUM GERMINALE. No. 2786a. Figs. 1-3, teliospores and basidia.
G. JUNIPERI-VIRGINIANAE. No. 2307a. Figs. 4, 5, teliospores and basidia.
G. NIDUS-AVIS. No. 2772a. Figs. 6-8, teliospores and basidia.
All x 715.

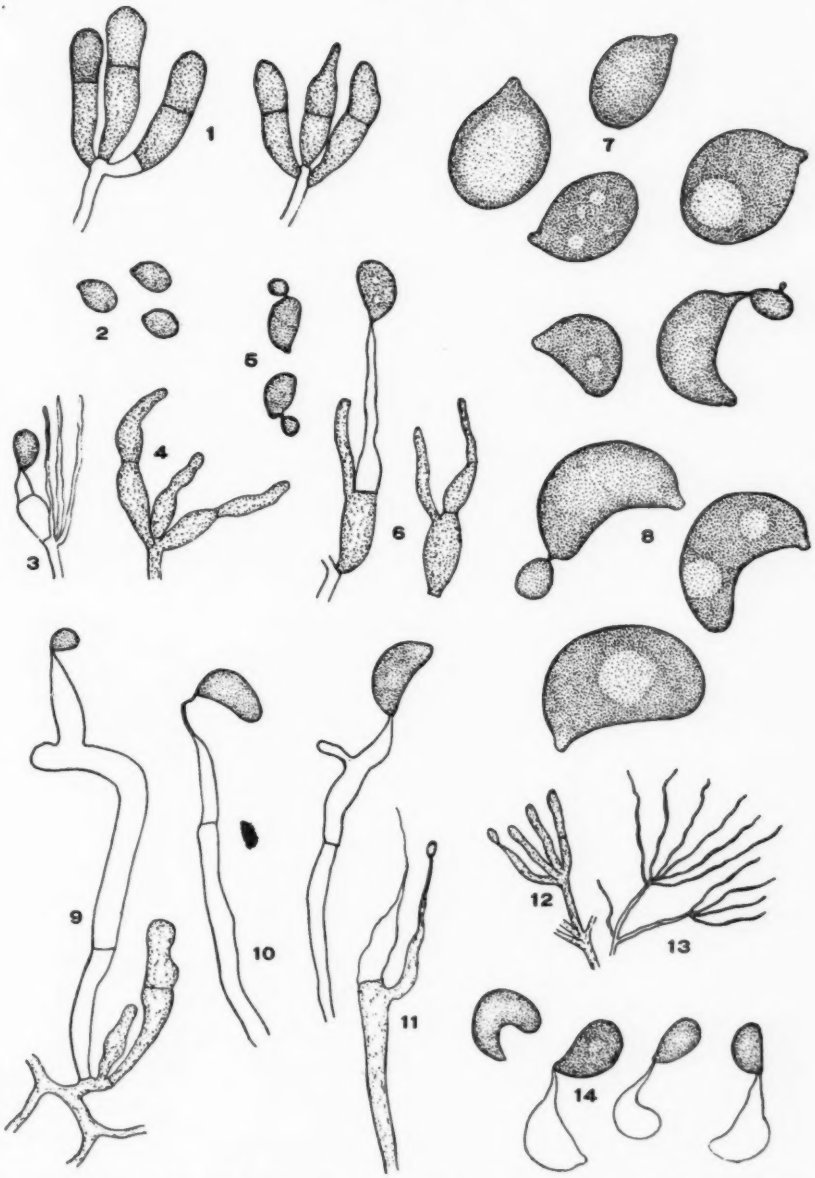
PLATE 53



SACCOBLASTIA OVISPORA VAR. CAROLINIANA. No. 4078. Figs, 1, 2, 4, 5, basidia showing spores and saes; fig. 3, sprouting spores.

AURICULARIA AURICULA-JUDAE. No. 3835. Fig. 6, spores; fig. 7, basidia. Fig. 6 x 2160, others x 1080.

PLATE 54



PLATYGLOEA CAROLINIANA. No. 4044. Figs. 1, 3, 4, 6, basidia; fig. 2, sporidia; fig. 5, sprouting spores; fig. 7, spores.

PLATYGLOEA LAGERSTROEMIAE No. 4062. Fig. 8, spores; figs. 9-12, basidia; fig. 13, threads among basidia; fig. 14, sprouting spores.

Figs. 7, 8 x 2160, others x 1080.

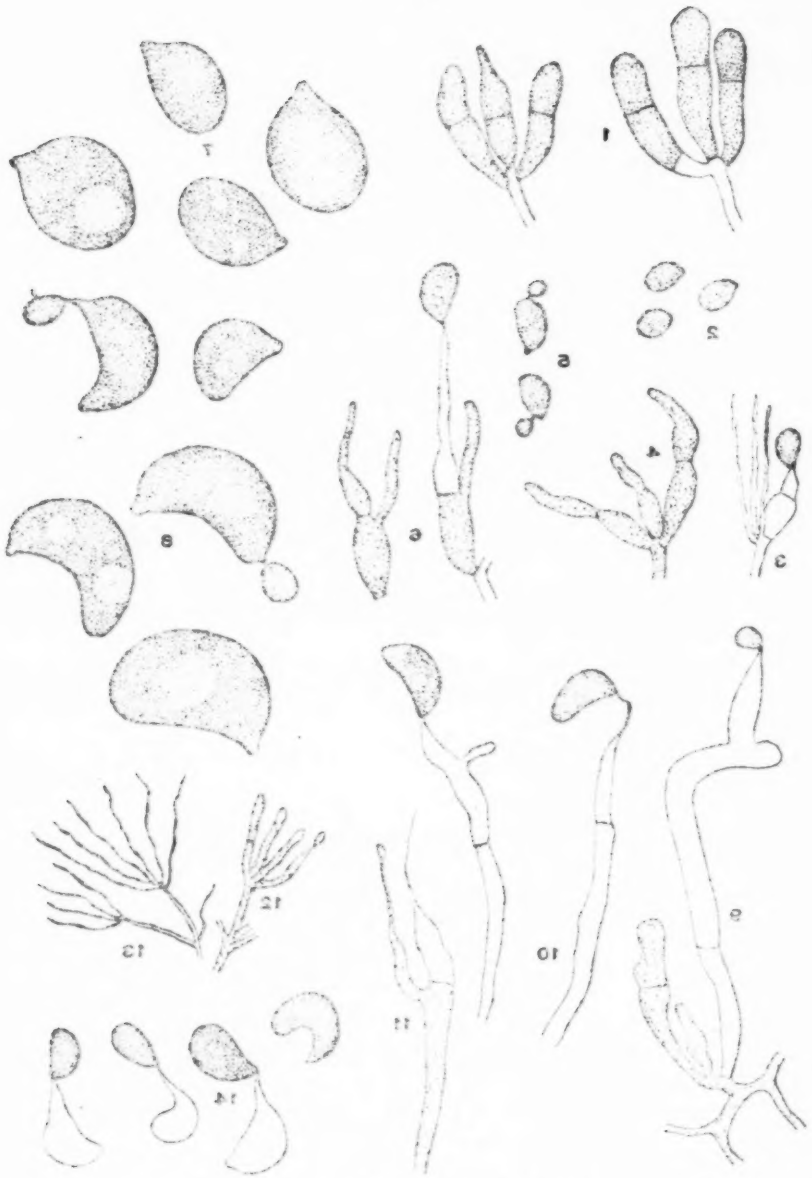

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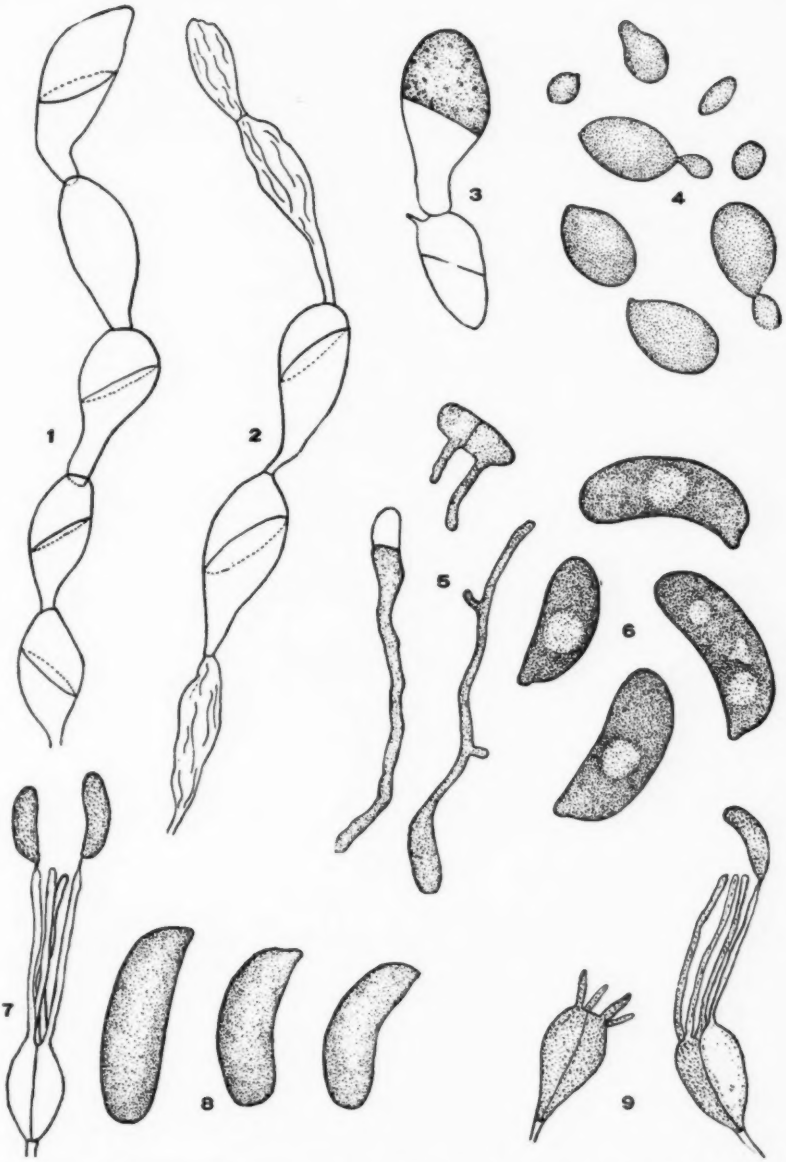
PLATE 55



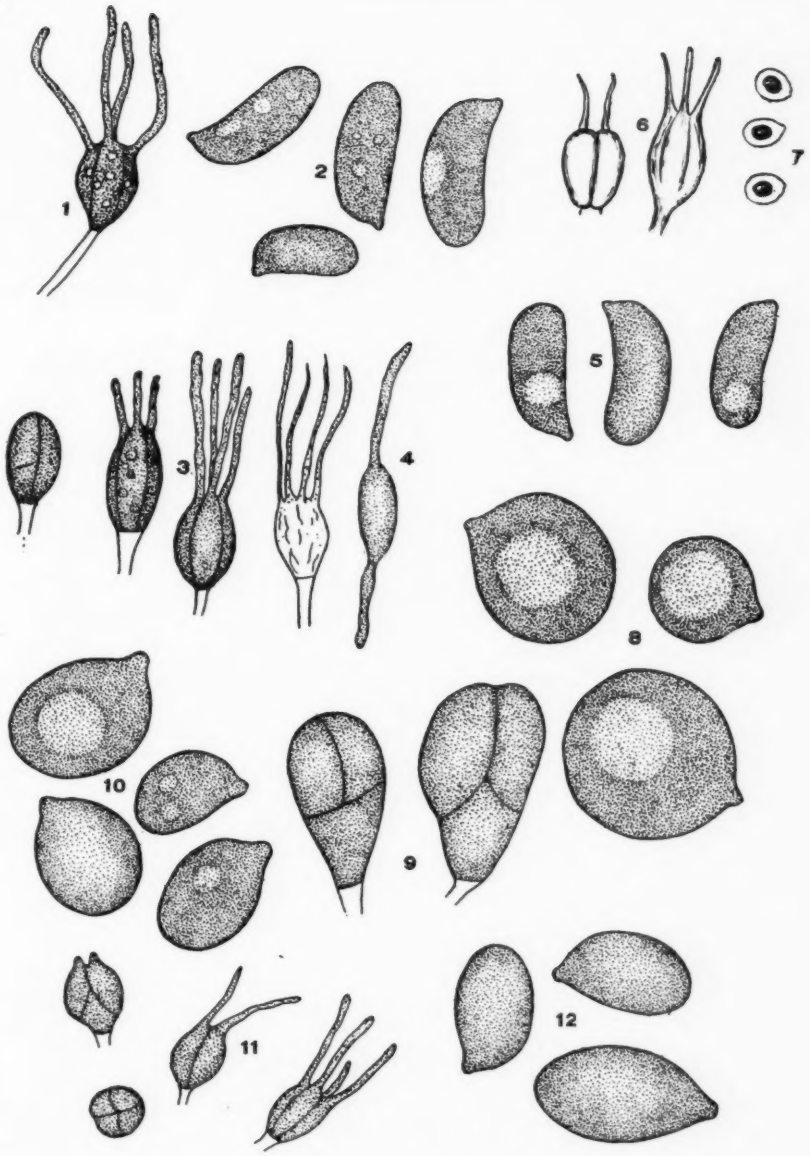
SIROBASIDIUM BREFELDIANUM. No. 4104. Figs. 1-3, basidia in chains; fig. 4, spores and sporidia.

EXIDIA GLANDULOSA. No. 3878. Fig. 5, sprouting spores; fig. 6, spores; fig. 9, basidia.

EXIDIA GELATINOSA. No. 3854. Fig. 7, basidium; fig. 8, spores.

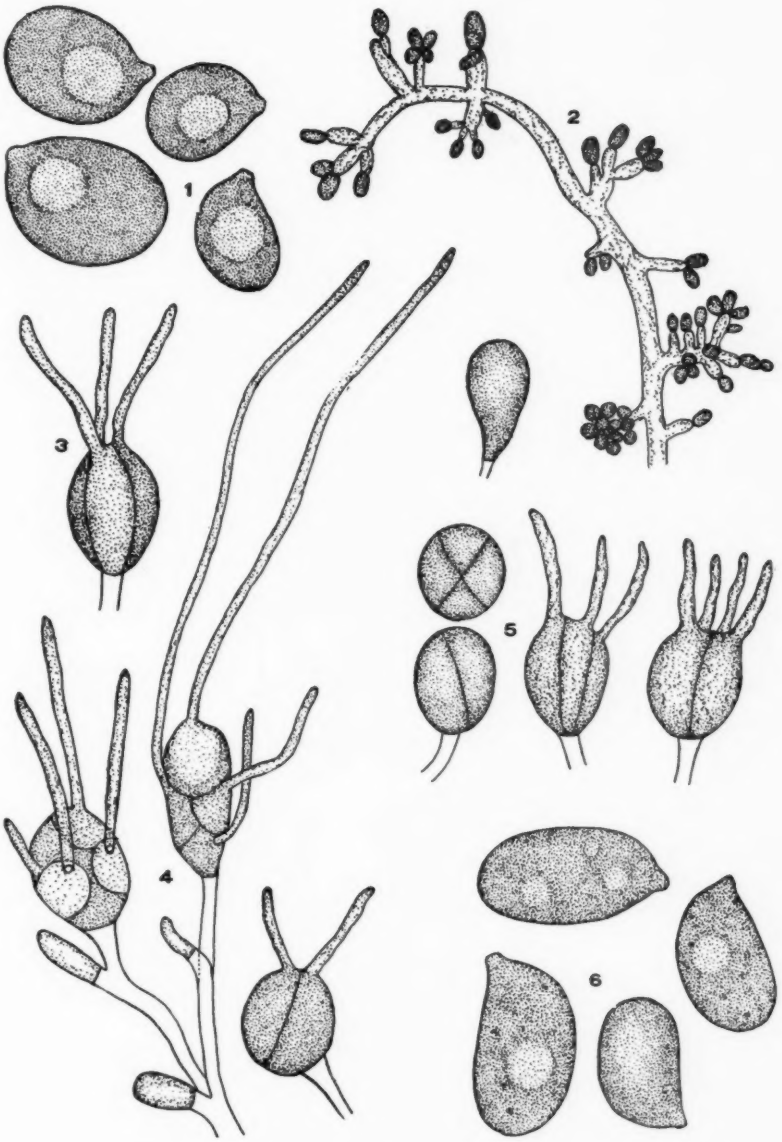
Figs 6 and 8 x 2160, others x 1080.

PLATE 56



EXIDIA BEARDSLEEI. No. 3930. Fig. 1, basidium; fig. 2, spores.
NAEMATELIA NUCLEATA. No. 3956. Fig. 3, basidia; fig. 4, sprouting spore. No. 3959. Fig. 5, spores.
TREMELLA FUCIFORMIS. No. 1408. Fig. 6, basidia; fig. 7, spores
TREMELLA ASPERA. No. 3950. Fig. 8, spores; fig. 9, basidia.
TREMELLA FRONDOSA. No. 4173. Fig. 10, spores; No. 2456. Fig. 11, basidia
TREMELLA RETICULATA. No. 2690. Fig. 12, spores.
Figs. 2, 5, 8, 10, 12 x 2160, others x 1080.

PLATE 57

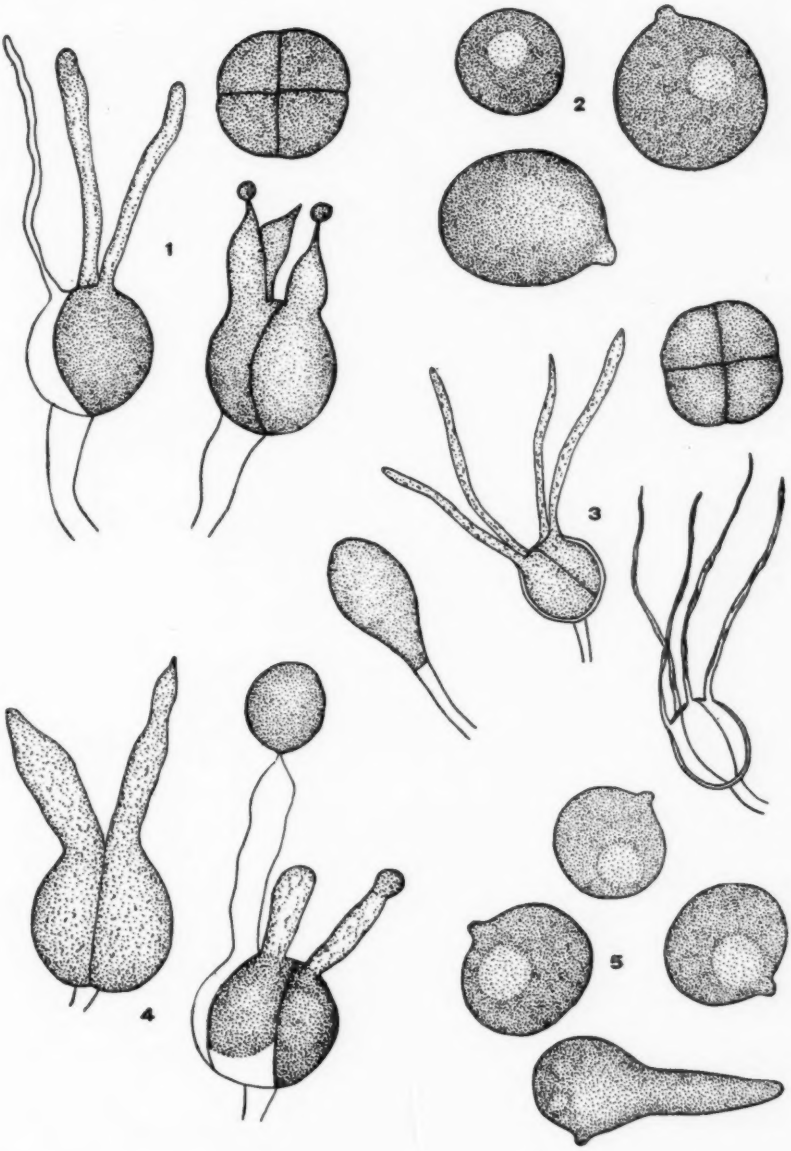


TREMELLA LUTESCENS. No. 3895. Fig. 1, spores; fig. 2, conidiophore (of No. 4069); fig. 4, basidia. No. 3916. Fig. 3, basidium.

TREMELLA VIRENS. No. 3070. Fig. 5, basidia; fig. 6, spores.

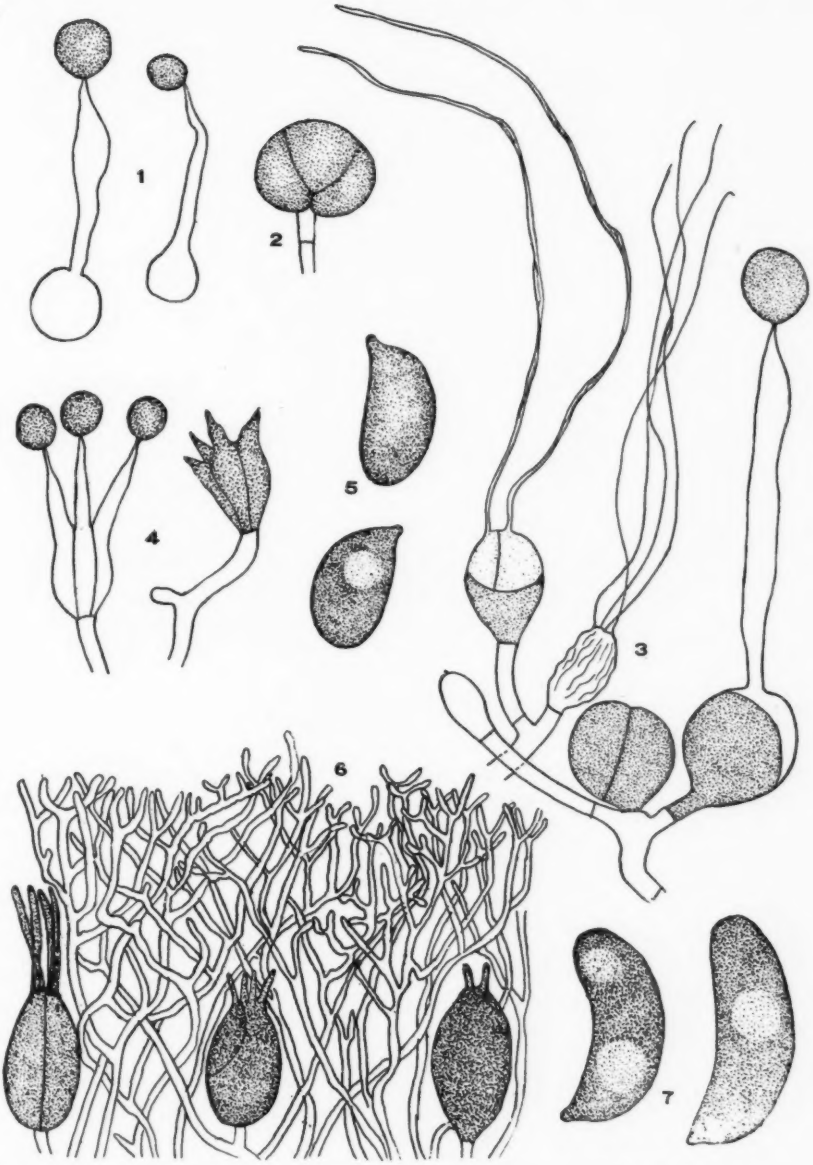
Figs. 1 and 6 x 2160, others x 1080.

PLATE 58



NAEMATELIA QUERCINA. No. 3935. Fig. 1, basidia; fig. 2, spores.
TREMELLA SUBANOMALA. No. 4005. Fig. 3, basidia; fig. 5, spores.
TREMELLA PINICOLA. No. 4050. Fig. 4, basidia.
Figs. 2, 5 x 2160, others x 1080.

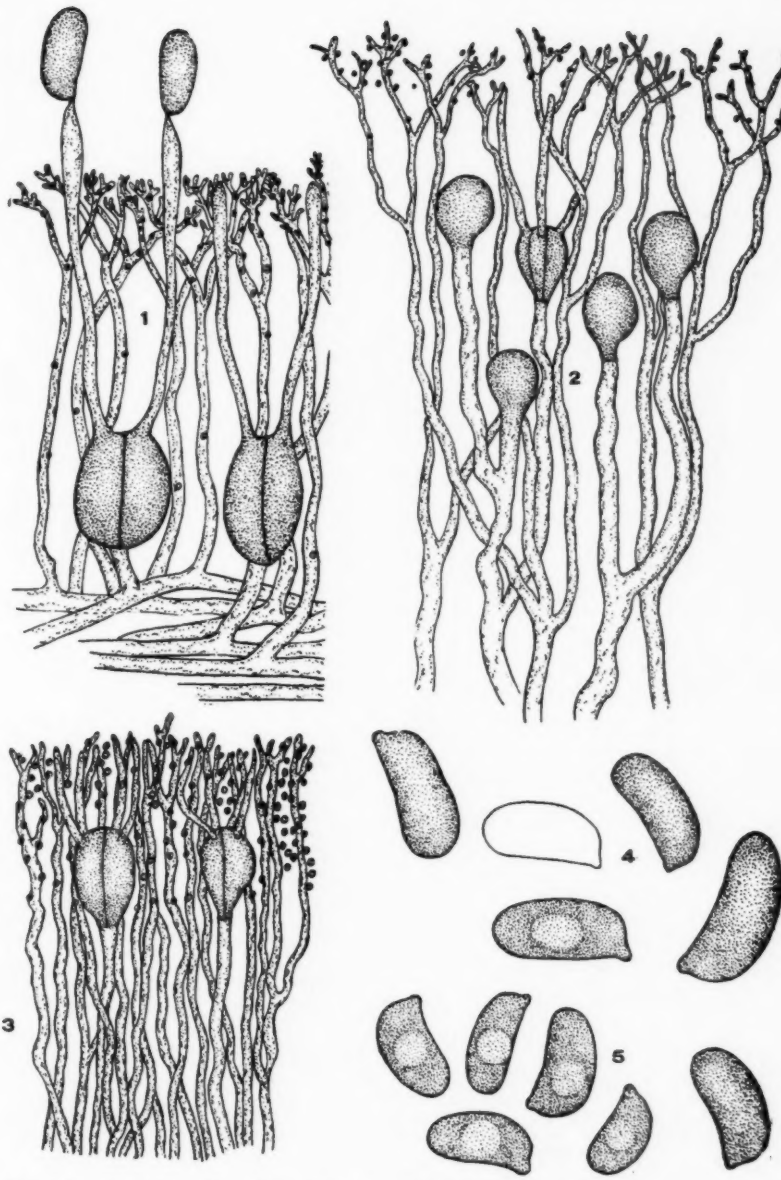
PLATE 59



TREMELLA CARNEOALBA. No. 3877. Fig. 1, sprouting spores; figs. 2, 3, basidia.
TREMELLODON GELATINOSUM. No. 912. Fig. 4, basidia and spores.
TREMELLODENDRON CANDIDUM. No. 1385. Fig. 5, spores.
EICHLERIELLA LEVEILLIANA. No. 3829. Fig. 6, section of hymenial surface, fig. 7, spores.

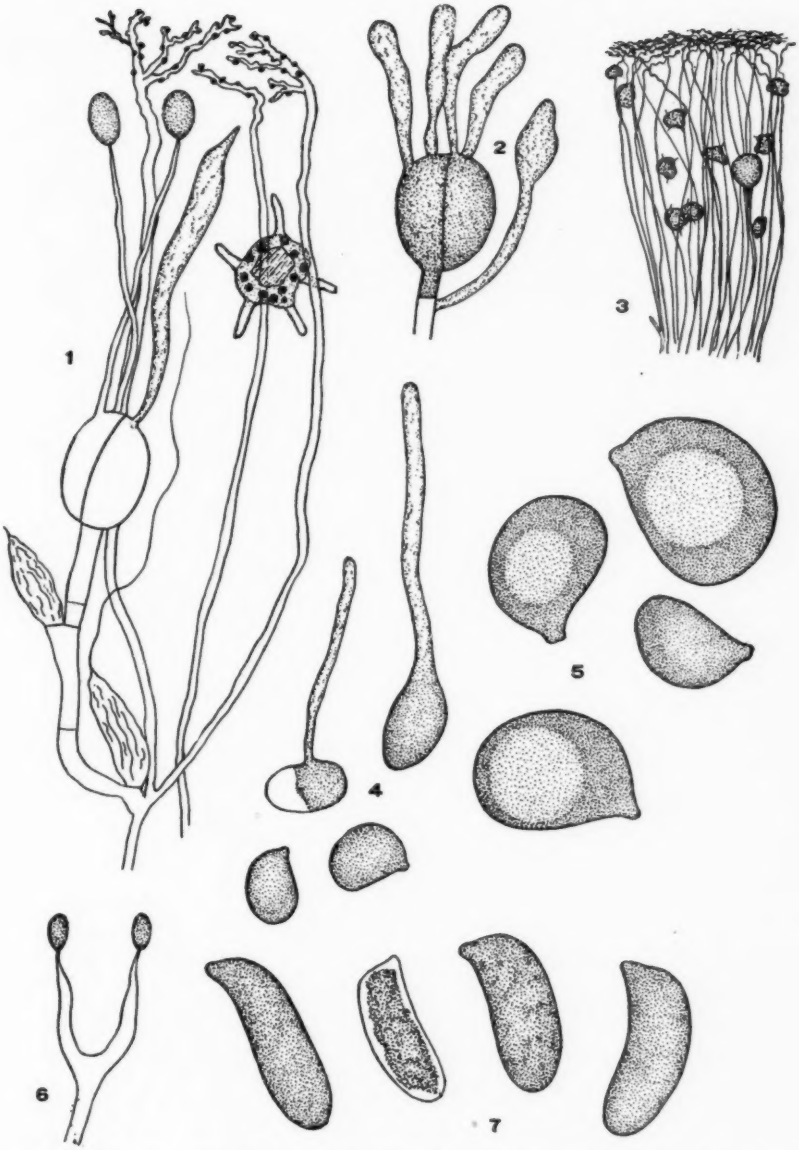
Figs. 5 7 x 2160, others x 1080.

PLATE 60



SEBACINA CALCEA. No. 3963. Fig. 1, section of hymenial surface.
SEBACINA SP. No. 4119. Fig. 2, section of hymenial surface; fig. 4, spores.
SEBACINA SP. No. 4118. Fig. 3, section of hymenial surface; fig. 5, spores.
Figs. 4, 5, x 2160, others x 1080.

PLATE 61

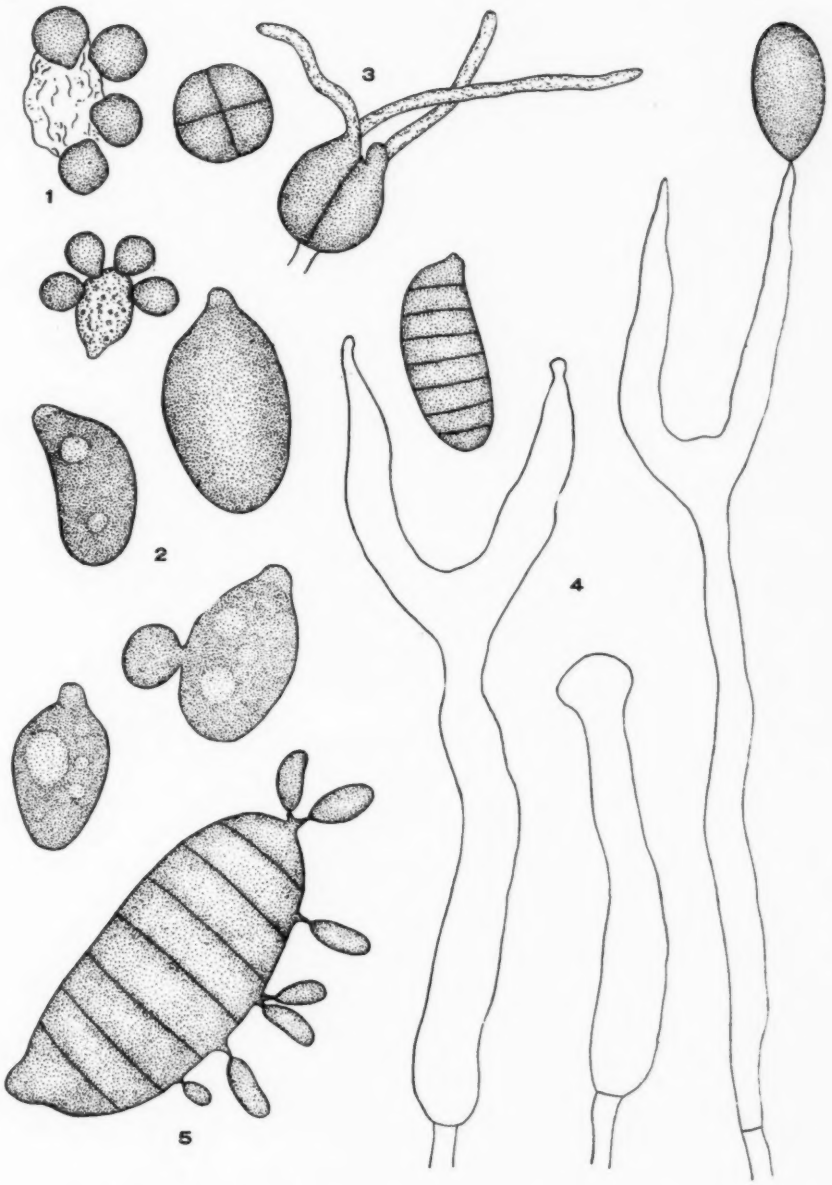


SEBACINA SP. No. 4116. Figs. 1, 2, basidia; fig. 3, section of hymenial surface, showing the large crystals; fig. 4, sprouting spores; fig. 5, spores.

DACRYMYCES PALLIDUS. No. 4072. Fig. 6, basidium; fig. 7, spores.

Fig. 3 x 370, figs. 5, 7 x 2160, others x 1080.

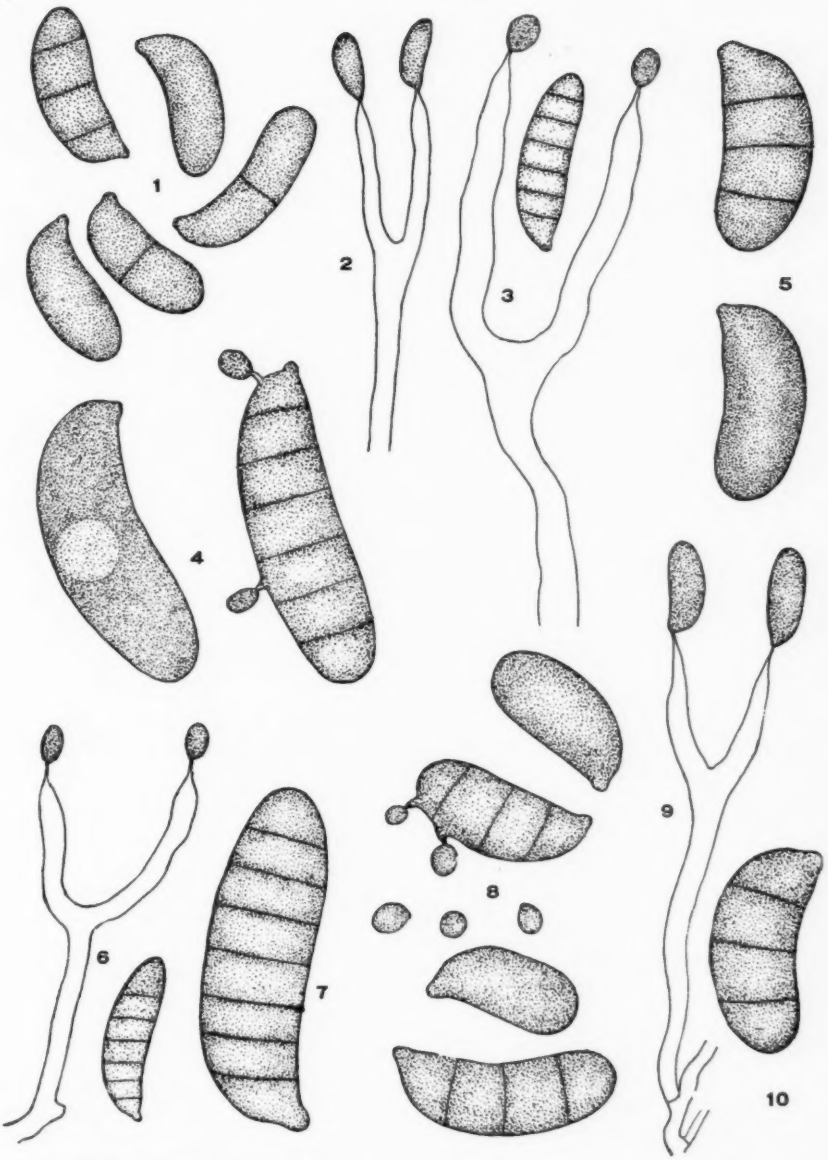
PLATE 62



TREMELLA AURICULARIA. No. 4159. Fig. 1, sporidia with remains of old spore; fig. 2, spores; fig. 3, basidia.

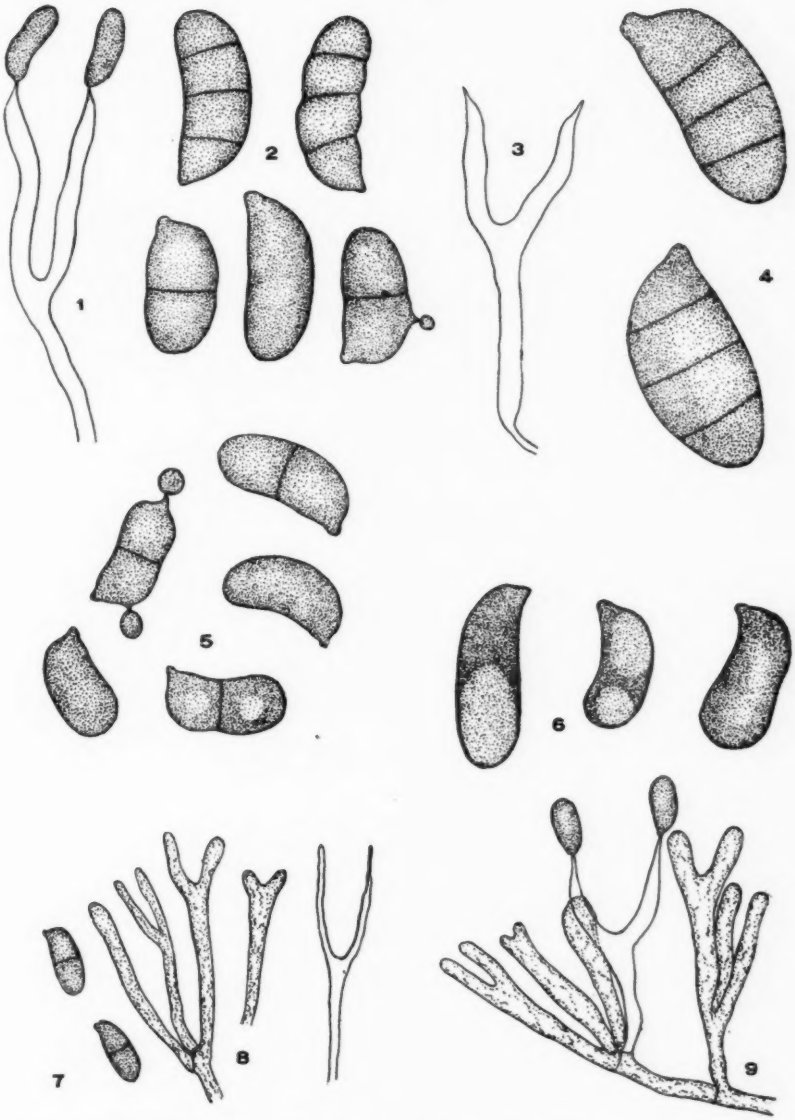
DACRYMYCES PEDUNCULATUS. No. 4158. Fig. 4, basidia; fig. 5, spores bearing sporidia. Figs. 1, 2, 5 x 2160, others x 1080.

PLATE 63



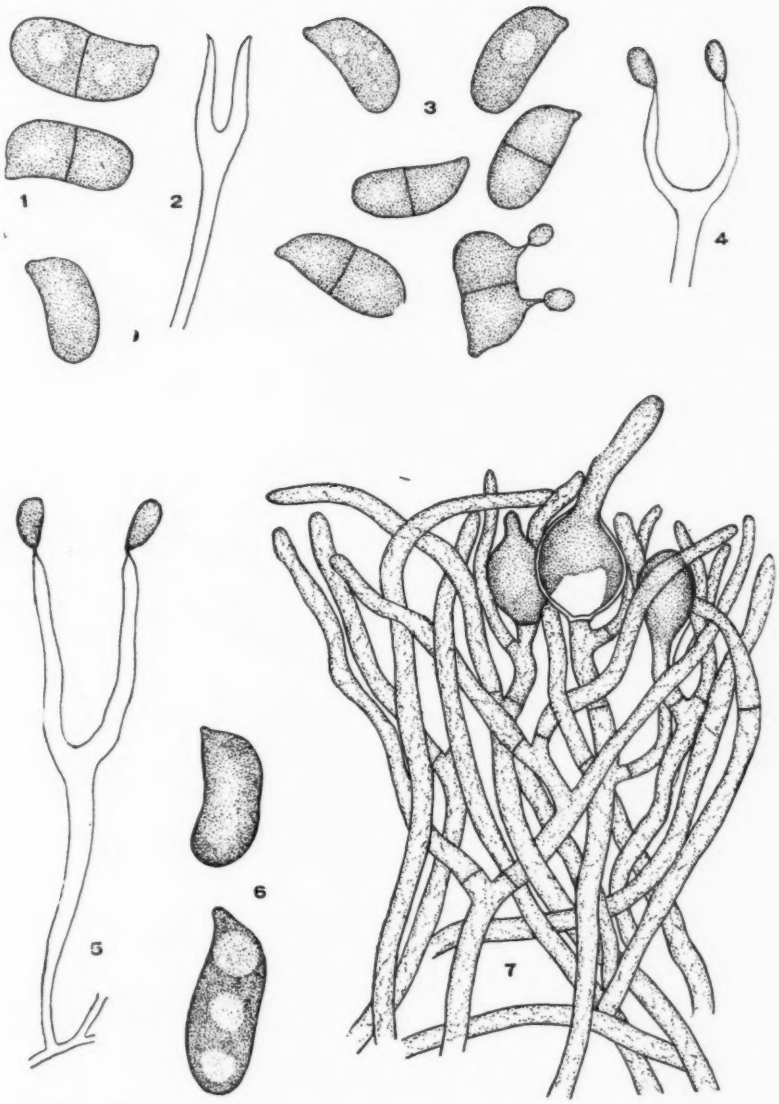
DACRYMYCES FUSCOMINUS N. SP. No. 4075. Fig. 1, spores; fig. 2, basidium.
DACRYMYCES ABIETINUS. No. 3832. Fig. 3, basidium; fig. 4, spores.
DACRYMYCES AURANTIUS. No. 3500. Fig. 6, basidium and spore; fig. 7, spore.
DACRYMYCES ELLISII. No. 3861. Fig. 8, spores and sporidia.
DACRYMYCES INVOLUTUS. No. 3972. Fig. 9, basidium; No. 4179. Fig. 10, spore.
DITIOLA RADICATA. No. 4183. Fig. 5, spores
Figs. 1, 4, 5, 7, 8, 10 x 2160, others x 2080.

PLATE 64



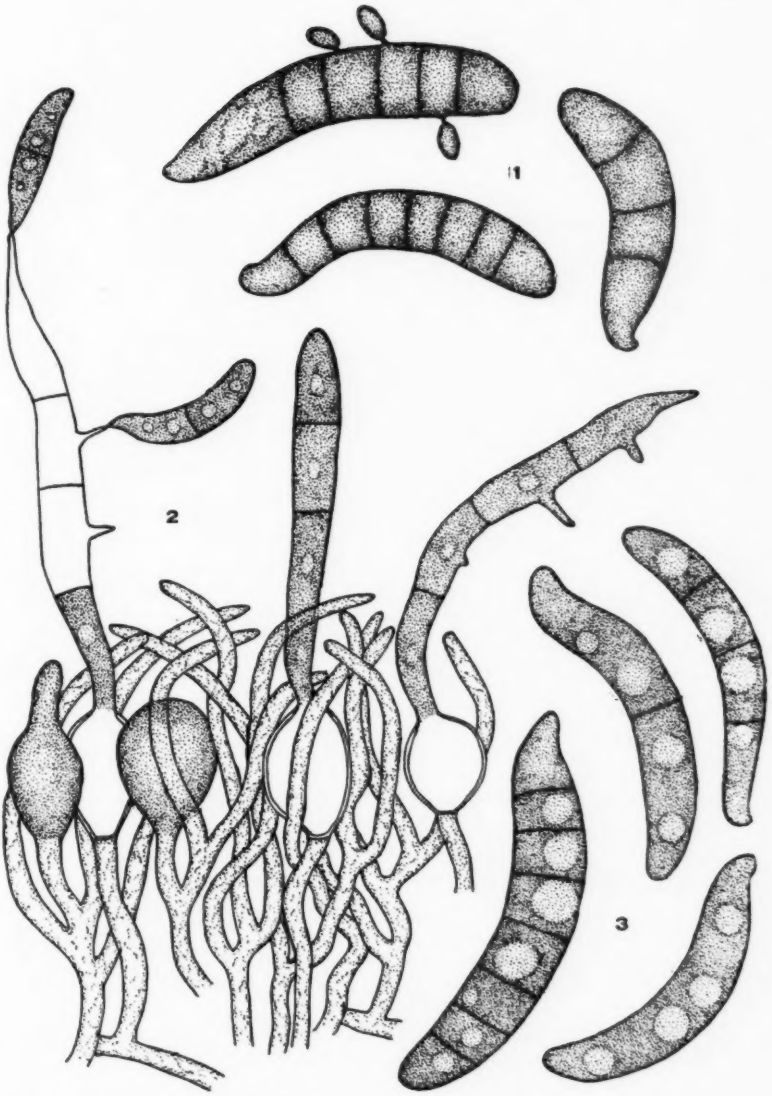
DACRYMYCES MINOR. No. 3926. Fig. 1, basidium; No. 4200. Fig. 2, spores
DACRYOMITRA DUBIA. No. 3969. Fig. 3, basidium; fig. 4, spores.
GUEPINIA SPATHULARIA. No. 3892. Fig. 5, spores; No. 3852. Fig. 6, spores; fig. 9, absidia.
DITIOLA ALBIZZIAE. No. 3996. Fig. 7, spores; fig. 8, basidia.
Figs. 2, 4, 5, 6 x 2160, others x 1080.

PLATE 65



CALOCERA CORNEA var. MINIMA. No. 4088. Fig. 1, spores; fig. 2, basidium.
DACRYOPSIS CERACEA. No. 4121. Fig. 3, spores; fig. 4, basidium.
CALOCERA CORNEA. No. 3834. Fig. 5, basidium; fig. 6, spores.
SEPTOBASIDIUM RETIFORME. No. 4279. Fig. 7, cross section of hymenial surface.
Figs. 1, 3, 6 x 2160, others x 2080.

PLATE 66

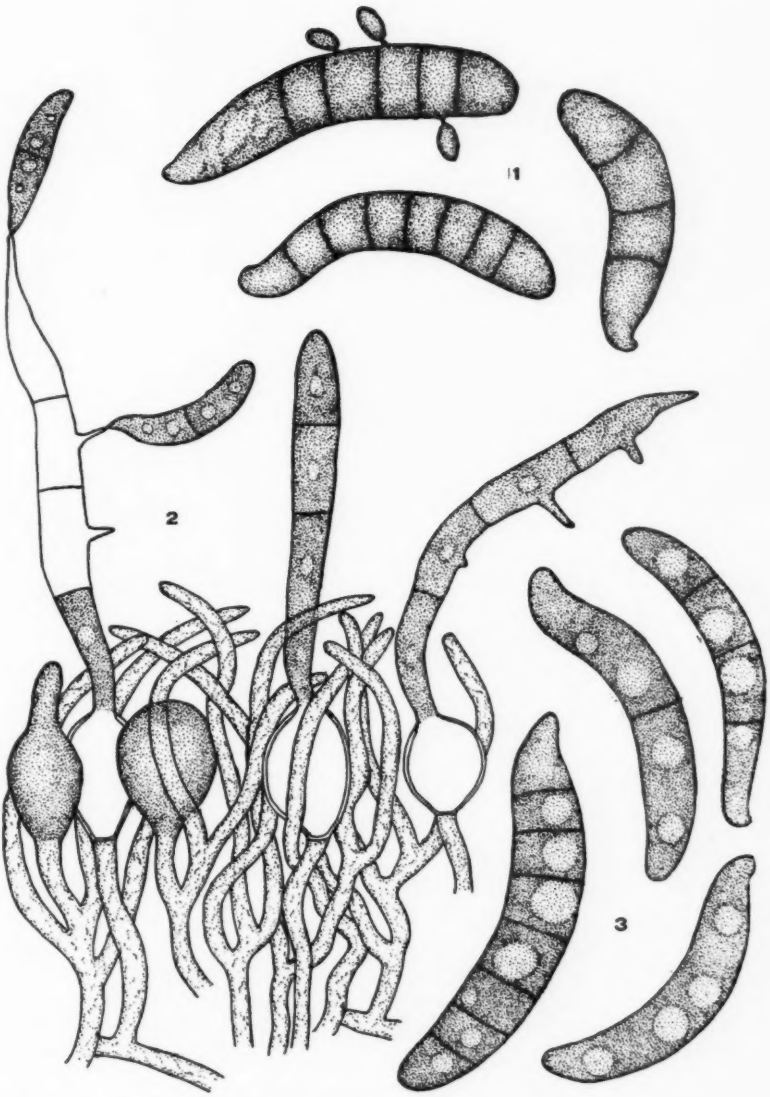


SEPTOBASIDIUM RETIFORME. No. 4279. Fig. 1, spores.

SEPTOBASIDIUM PSEUDOPEDICELLATUM. No. 4286. Fig. 2, cross section of hymenial surface; fig. 3, spores.

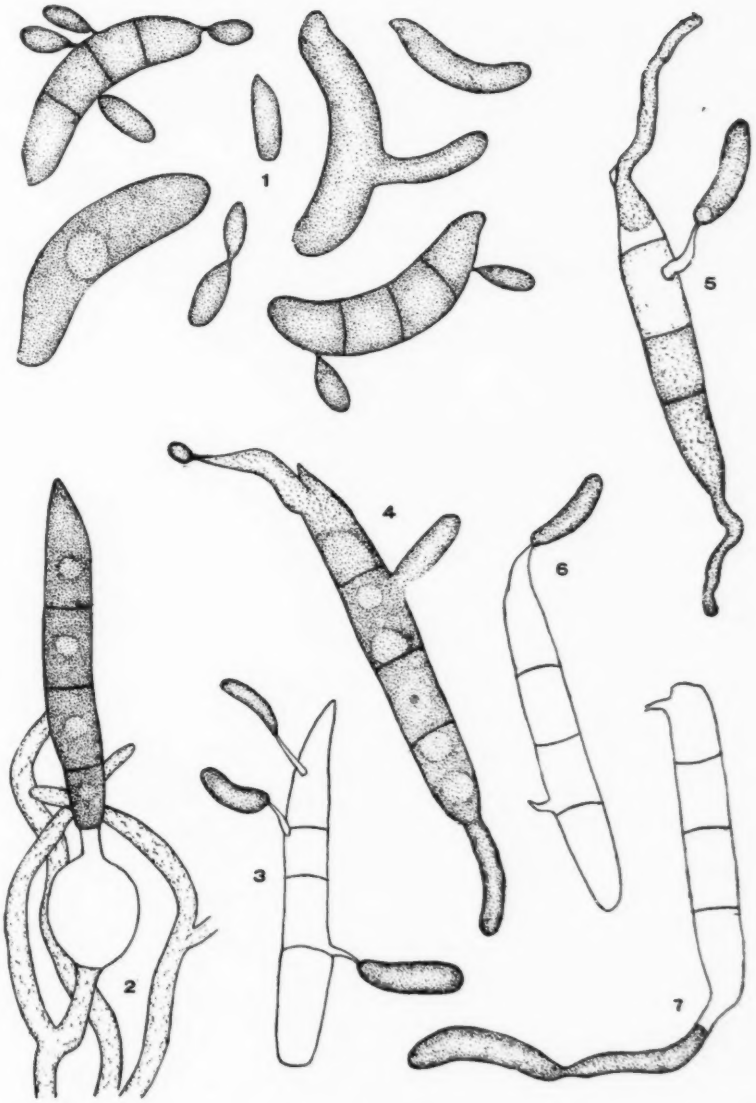
Figs. 1, 3, x 2160, fig. 2 x 1080.

PLATE 66



SEPTOBASIDIUM RETIFORME. No. 4279. Fig. 1, spores.
SEPTOBASIDIUM PSEUDOPEDICELLATUM. No. 4286. Fig. 2, cross section of hymenial surface; fig. 3, spores.
Figs. 1, 3, x 2160, fig. 2 x 1080.

PLATE 67



SEPTOBASIDIUM PSEUDOPEDICELLATUM. No. 4293. Fig. 1, spores and sporidia.
SEPTOBASIDIUM RETIFORME. No. 4294. Fig. 2, section of surface showing origin of basidia; figs. 3-7, basidia forming spores.
Fig. 1 x 2160, others x 1080.